TOTAL ATOMIC DEFENSE

SYLVIAN G. KINDALL

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Greatest discovery since the discovery of fire, millions of times more powerful than fire—that's atomic energy. Soon it may be supplying the world with all the energy needed for light and heat and for turning all its machinery. Unfortunately, though, the earliest principal uses of atomic energy probably will be in the services of war.

This book grimly warns that air-raid shelters, corps of volunteer fire fighters and stretcher bearers, and other measures of TNT-bomb defense borrowed from London will be woefully inadequate to cope with the savagery of the atomic bomb—a missile more powerful than all the thousands of tons of TNT bombs dropped upon London during World War II. If our civilian atomic defense is not ready by the time the next great war starts, all our cities exceeding 15,000 population, of which there are exactly 837, are likely to be rewarding targets for bombing. In these cities 25 million people can be killed and the cities themselves blasted into mounds of ruin.

But in spite of the almost incredible power of the atomic bomb the author strongly insists that cities can become unrewarding targets for its use, and consequently in no danger of being bombed, if they will expand their areas adequately and remove target plants and factories to their perimeters. In short, he advocates a defense concerned with keeping cities from being attacked rather than with trying to put out fires and bind up wounds after the cities have been all but blasted from the face of the earth.

(Continued on back flap)

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GREATER THAN FIRE

IT IS HARD to imagine how the human race lived before the age of fire. The cooking pot and water jug molded from soft clay and baked to durable hardness in a fired pit, the axe-head and arrow-tip of fire-splintered flint, the metal knife blade, the hammer, the saw, the clock, the navigator's compass, the printing press, the steam engine, the machine reaper and on up to the robotistic machinery of the modern age—all are products of the first great basic art given to man, the art of producing a fire by artificial means. Without fire to change the texture of substances, no apparatus, tool or utensil could ever have been made.

And now, after thousands of years since the age of fire began, there has been placed in the hands of man a second great basic art, one which may prove even greater than the art of kindling a fire. It is the art of smashing atoms, to get from them an energy millions of times more powerful than the energy released from any substance by the action of fire. If we cannot form any clear and wholly acceptable idea of how man lived on earth before the age of fire began, because of the dense darkness overspreading his antiquity, for the opposite reason—the blinding light from ahead

—we cannot even begin to foresee what achievements he may attain before men now alive have passed.

For the second half of this whirling century of ours we can set our imaginations to almost any goal, and no one can say that it will not within that time be reached. A man is not to be called a fool who believes that before our earth has been thrown another fifty times about its colossal star, the sun, such things as space ships will be exploring the other side of the moon. Neither is he to be called a fool who believes that if intelligent beings exist on any of the other planets we shall some day have a chance to hear their voices and see their faces, and profit from whatever untold mysteries of the universe they have fathomed. With useful atomic energy already a fact these things no longer belong entirely in the realm of fantastic dreams. A down-to-earth and less hazardous guess, though, is that within only a decade atomic energy will be driving palatial ships across the ocean and sending airplanes on non-stop flights to the corners of the world and back. And within another decade after that atomic energy will probably be the means for gathering the power now spilling into waste at remote waterfalls, bringing it to light and heat and cool our homes, and to turn all the wheels of machinery.

But if the future follows the examples of the past, the earliest principal uses to which atomic energy is put will be for the purpose of willful destruction. Man, Caucasian man in particular, has never lost much time turning his latest invention or discovery into an implement of war, if it has a value for tearing human soul from flesh and bone. Among the first articles of metal he forged after he had

learned the art of smelting were spears and daggers for the battlefield. The Assyrian soldier was slashing down his foe with an iron sword three thousand years before the tiller of soil was given a piece of iron to improve the forked stick which, since time immemorial, he had used for plowing the field. Christian voyagers of the Middle Ages had not long brought back from China the knowledge that a mixture of charcoal, sulphur and saltpeter forms a combustible mass which the Chinese exploded in small paper cylinders to make a big noise on joyous occasions, before these three substances were being stirred together and used to fire a cannon ball. Indeed, the new name *gunpowder* selected by the Europeans for the discovery imported from China, indicates for what use they believed it most profitably could be employed in Christian hands. The fledgling airplane was scarcely able to lift itself in short flights above the ground before it was being studied for a military weapon. The radio served on the battlefield before it came to entertain in the home. And the atomic bomb dropped on Hiroshima in 1945 proved that the first practical use of atomic energy would be as a weapon of war.

For the present, then, while scientists and technicians are perfecting the means and methods for harnessing atomic energy for all the many purposes to which it eventually will be put, the crucial duty for the rest of us—and this is the concern of this book—is to learn how we can prevent this energy from ever being turned loose upon us as an instrument of death and devastation.

It is generally assumed that when the next world war comes our transports by the hundreds, escorted by our

navy, will again be plowing across the oceans, as they did during the first two world wars. In fact, the public has already been told by persons high in public office that our nation again at war will have the task of ferrying overseas not less than five million soldiers, and everything with which to arm, equip, and feed them.

Unless we wish to believe that other nations are taking no notice of our much discussed overseas commitments and the billions of dollars appropriated for them, we must expect that when the war does start the strategy of the enemy will be to attack with atomic bombs all of our important cities and other vulnerable major targets in a supreme effort to cripple us so badly that not for many months will our ships be able to leave our ports with any considerable number of soldiers and amounts of military equipment and supplies. The enemy will know, of course, that if he can set back by six months or a year our time-tables for mobilizing, training and equipping the number of divisions we have planned to send overseas, his own land armies in the time thus gained will have a good chance of battering down the thin wall of Allied forces trying to hold the initial front.

Indeed, because the atomic bomb is the ideal weapon for immobilizing and delaying, and is the only weapon that can reach and destroy us in our homeland, we can be sure that any potential enemy who has learned how to manufacture the bomb will spare neither resources nor money to build a stockpile of several thousand. And his factories and munitions plants will be busy day and night turning out the long-range planes, rockets and other craft and

devices by which his bombs can be dropped on targets throughout our country.

Among the thousand or more spots and objects in our country that will become major targets for the atomic bomb—unless we have achieved atomic defense before the next great war starts—it is useless to speculate as to which the enemy will single out for his initial attack, for in all probability his bolts will be thrown during the first day of war at a score or more of widely separated places. Indeed, it is as unlikely that only a single plane will make the first attack as that the war on land will start with only a single platoon leader blowing his whistle and leading off with his one platoon. Wars no longer start with a skirmish at Concord Bridge. Many will remember that Germany in 1914 crossed the frontiers with whole armies and groups of armies within the first few days of war. Again in 1939 Hitler started World War II with fifty-six divisions pouring into Poland from three sides. In 1940 with an even larger force he sprang the invasion of Norway and the Lowlands, and next year he opened the war against Russia with one hundred and seventy divisions clanking across the frontier. If our atomic defense is not ready, a similarly heavy attack, this time from the air, is what we can probably expect as the opening act of war. In that event the very first day of the new world war could be a hundred times more terrible than any day of slaughter and ravage the world has yet known.

Over the top of the world, across the arctic wastes, across Canada, past our northern boundary and on through the Mississippi Valley will race fast planes, almost invisible

to the eye, streaking toward marked targets. From other directions will come more planes and out at sea submarines will surface to launch inland long lean rockets. Los Angeles, Glendale, Long Beach with its miles of man-made harbor, Santa Monica, Pasadena stand clustered in a single area of destruction. None of it will escape. Where now there is so much of enterprise and bustle, beauty and adornment, fabulous luxury and extravaganza, there will be scorched earth and charred ruin. Houston, the port on the prairie, which presumes to build a skyline rivaling New York's, will be among the first of the cities to perish. With it will go Galveston and Texas City, together with dozens of smaller cities, hundreds of refineries, chemical plants and terminals fringed about Galveston Bay. In a day all will be smothered in destruction, with billowing clouds of black and yellow smoke and the suffocating fumes of burning chemicals drifting inland for miles across the coastal plain.

The automobile that built Detroit, Dearborn, Pontiac, Flint, will cause their destruction. In a day their belching smokestacks and miles of crawling assembly lines will be twisted and bent into tangled masses of iron junk. Steel will be the end of Pittsburgh, the Calument region in Indiana, Birmingham. The congestion of Boston and the ring of cities around it will make them a target. Immensities of population and crowded industries will destroy the metropolitan areas of Chicago, Philadelphia, Cleveland, Baltimore. Port facilities will draw the bombardiers to Norfolk, Charleston, New Orleans, Mobile, Seattle, both Portlands, the cities of San Francisco Bay, San Diego,

Lake Charles, Corpus Christi. Chaos complete will be achieved by the destruction of Washington, seat of our federal government.

On that first day at least twenty other cities will suffer the annihilation now being predicted for New York alone as the Number One city for the atomic bomb. But the fates of these other cities will not soften the blow upon New York. The whole of its metropolitan area, extending across the river into Jersey City, Newark and the Oranges, and in the other direction into Connecticut and far out on Long Island will be rocked and jarred from one bomb explosion after another. The tall buildings will shed their facings of brick and terra cotta. The bridges spanning the rivers and bays will splash into the water. The tunnels beneath the rivers will crush like egg shells. Before the end of that day where now stand Manhattan, Brooklyn, the Bronx, Jersey City, Newark, New Rochelle, will be mounds of rubble, with the steel skeletons of the stripped skyscrapers standing out from the smoking heaps like forests of dead snags.

When the sun sets in the murky sky at the end of that first day of the new world war, 25 million people will be dead, all of our cities of super-size or first in industries will be in smoking ruins. Our federal government will be gone, our major ports wrecked and a good part of our giant industrial plants broken and crushed and in flames. It will be like the day after the end of the world.

But the destruction will not end with that one day of slaughter and wreckage. From the second day on the enemy's fast, huge planes bearing atomic bombs will con-

tinue to streak across the skies. All of our large cities that escaped the surprise attack of the opening day of the war will be destroyed. St. Louis, Milwaukee, Buffalo, Minneapolis, Cincinnati, both Kansas Cities, Dallas, Indianapolis, Denver, San Antonio, Memphis, Columbus, Louisville, Rochester, Atlanta, St. Paul, Toledo, Fort Worth, Akron, Providence, Omaha, Miami, Dayton, Oklahoma City, Richmond, Syracuse, Jacksonville, Worcester, Salt Lake City, Tulsa, Hartford, Des Moines, Grand Rapids, Nashville, Youngstown, Wichita, New Haven, Springfield, Spokane, Bridgeport, Yonkers, Tacoma, Paterson, Sacramento, Albany, Charlotte, Fort Wayne, Austin, Chattanooga, Erie, El Paso, Trenton, Shreveport, Scranton, Camden, Knoxville, Tampa, Baton Rouge, Cambridge, Savannah, Canton, South Bend, Peoria, Wilmington, Evansville, Reading, Allentown, Phoenix, Montgomery, Waterbury, Duluth, Utica, Little Rock—all will be totally destroyed.

The middle-sized cities will share the same fate as the large cities. Many of these middle-sized cities are important ports or have factories equipped to turn out essentials of war. Some, like Oak Ridge and Hanford, have special significance. For the others, their stores of foodstuff, their housing and the potential military manpower and industrial manpower they represent still will make them profitable targets.

If the season is right, or when it does become right, the ripening fields of wheat of the semi-arid West will be strewn with incendiary fires. Thousands of square miles of the nation's breadbasket will be lost. And like the fields of

ripening wheat, the magnificent forests of firs and pines of the West, so difficult to protect even during seasons of ordinary heat and dryness against only the accidental fires, will go up in smoke and flame.

Moreover, the great dams across the rivers are doomed. The greatest of these represent the mightiest works ever built, surpassing in tons of masonry even the pyramids of the Egyptians. But their massiveness and strength will not save them. What man has built man can also destroy. Before the might of atomic power the solid walls of concrete fibred with rods of steel will be only plaster and lath. Grand Coulee will be split asunder. Three trillion gallons of released water will race down the Columbia River. City after city along the overspread banks will be swept away. Hanford, if not already destroyed by blast and fire, will be destroyed by wash and flood. Portland, already in flames, will be flooded in a backwash of the Willamette. Onward the deluge in a towering wave will rush to the sea, bearing upon its frothing crest a chaos of houses and sheds lifted from their foundations and whole forests torn up by the roots.

Like Grand Coulee, Hoover Dam on the Colorado will be split apart, and, in chunks as big as courthouses, tumbled into Black Canyon. All of Lake Mead, a man-made inland sea impounding ten trillion gallons of Colorado River—enough water to cover an area the size of New Jersey to a depth of six feet—will be turned loose in seconds, to rush to freedom with a roar that will set the hills miles away trembling to their cores. At its lower reaches the rampaging river, as it has succeeded in doing during more

than one seasonal flood, will break into the torrid Salton Sink, that strange piece of land whose sunken surface lies below the level of the sea. But this time it will fill the basin to its brim, covering with flood dozens of towns and villages and destroying hundreds of thousands of acres of vegetables and fruit groves.

As go the dams of Grand Coulee on the Columbia and Hoover on the Colorado, so also will go Fort Peck on the Missouri, Wolf Creek on the Cumberland, Kentucky on the Tennessee, Fontana on the Little Tennessee, Denison on the Red, Shasta on the Sacramento, Norris on the Clinch, Kingsley on the North Platte, Elephant Butte on the Rio Grande, Saluda on the Saluda, Garrison on the Missouri and at least forty more of the largest of the dams.

Vast areas of the West, reclaimed by dams from the desert, that now in season are green with crops and orchards, alive with water in irrigation ditches glistening in the sun, and dotted with rural homes and thrifty villages, will go back to gray desert. Crops and orchards will wither; cattle will low at the dry pools and empty troughs. A million people who now are living by the gift of water lifted above the natural beds of the rivers and carried by gravity through canals and ditches, will be wandering the highways in search of places to live, even in search of food, through regions already overrun with hordes of hungry, desperate refugees who have fled the doomed cities.

The mines from which come most of the iron, copper, zinc and lead that our manufacturing plants require, will

have their pits and ore-lifting machinery blasted to ruin and their areas sown with deadly radioactivity. If there is anywhere in the land a large ore mill that escapes destruction by bombing, it will be left standing idle because no sources of ore will be available to it for months, perhaps years.

But the aim here is not to try to name every spot and area in the United States that will be destroyed *unless we have total atomic defense ready by the time the next World War comes*. In fact, it scarcely is possible to name every target our potential enemy probably has already explored, found vulnerable and made a detailed plan for its destruction. Without much doubt he is able even from his own continent to discern spots of vulnerability on ours which we ourselves may not readily see. He can do this, in the first place, because it is his business to put trained personnel to the work of searching and probing our country for its spots of greatest weakness; and, in the second place, he has the advantage of looking upon us at a distance, from which we can be seen in perspective. It is always that way when one nation seriously searches another nation for its vulnerable spots.

Pearl Harbor is a good example. Japan with the advantage of looking upon us from a distance was able to see our entire Pacific fleet squatting on that one tiny basin of water, a sitting duck for a perfect pot shot. But apparently no senior officer in our navy, not even after Washington had given notice that war with Japan could come any day, had had so much as a premonition that all the battlewagons and their auxiliary ships in Hawaiian

waters might be sunk or seriously crippled in one blow from the air if they were not dispersed.

An even better example is Singapore. After World War I Britain stood in need of a great naval base in the Far East to give security to parts of her empire lying east of Suez. Singapore at the tip of the long club-shaped Malay Peninsula was selected for the location, because of its position on the flank of all the sea routes from Europe to the Eastern Asiatic countries. Work was started upon the great base as early as 1923, and when finished a decade and a half later, complete with emplacements, guns of the heaviest and most modern types, dockyards, shops, storehouses and barracks, it was declared the world's strongest fortress. Yet Singapore fell to the Japanese on February 15, 1942, after only six days of fighting. With it went one hundred thousand British and Colonial troops in what Churchill calls the "worst disaster and largest capitulation in British history." What happened at Singapore was that the Japanese, instead of attacking the impregnable fortress from the sea in the kind of engagement it had been built to drive off, landed ground troops upon the peninsula well above Singapore, marched them southward through the jungle, and fell upon Singapore from the rear.

It was as simple as that. The great fortress, it was suddenly discovered to the dismay of its defenders, was not prepared to deal with an attack by land. No land forts had been built to cover the rear and none of the great guns covering the sea side had been so placed that, if necessary, they could be swung completely about to bring their fire to bear upon the mobile guns of an enemy trying

to sneak up on the fort from the land side. Churchill, who, like his associates, had never given a thought to the fortress having a weakness on the land side, says: "It never entered my head that no circle of detached forts of a permanent nature protected the rear of the famous fortress. I cannot understand why it was that I did not know this. But none of the officers on the spot and none of my professional advisers at home seem to have realized the awful need. I do not write this in any way to excuse myself. I ought to have known. My advisers ought to have known, and I ought to have been told, and I ought to have asked."

After what happened at Pearl Harbor and Singapore, let no one think that, if we do not talk above whispers among ourselves about our overcrowded cities, our defenseless great dams, the wheat fields and forests of our West and our exposed pockets of valuable ores, the enemy will never know about them. If we could look at the wall maps of his war room we probably would find all of these features already located and stuck with beaded pins, some marked to be destroyed and some to be neutralized among the first of the targets attacked and the others to be set upon after all targets of earlier priority have been dealt with. It is also likely that on his war maps of our continent are located many other important features whose vulnerability to atomic attack stand out boldly and distinctly as seen from his distant observation post, but which we ourselves, because we are standing on top of them, are scarcely able to see.

After the surprise attack upon our super and strategic

cities on the opening day of the war the millions of families living in the hundreds of other large and middle-sized cities that escaped the destruction of the first day will naturally start seeking safety in the open country. They will be escaping with their lives, the clothes on their backs, a few articles grabbed up in haste and tossed into their automobiles, and nothing more. Left behind in their houses, to be destroyed by fire or flood, will be furniture and furnishings and all extra clothing. Also left behind in their cities and completely abandoned by everyone will be tons of foodstuffs at the grocery stores and warehouses, meats at the markets and packing plants, livestock at the slaughtering pens, wheat and flour in elevators and mills, gasoline and oil at the storage tanks and clothing of all kinds at the clothing stores. Joining all these millions of people fleeing from the abandoned cities will be another million desperate souls driven from the areas left waterless by the destruction of the big irrigation dams.

At the end of an estimated thirty days of blitzkrieg from the air, when the enemy has struck down with atomic bombs all the cities marked on his maps for destruction and the skies are calm once more from the month-long slash of planes and rockets through the skies, probably not less than 25 million refugees from the doomed cities and withering lands will be living as homeless as gypsies. Among the farmhouses and among the small villages and towns, which by then it will be known that the enemy does not intend to attack with atomic bombs, this mass of wretched humanity will have to search for temporary shelter. Many will need luck to find as much as a single

room, a garage or a woodshed that can be furnished with a bed and a stove. Food will be an even greater problem than shelter. With the loss of the wheat fields of the semi-arid West and the loss of the millions of tons of foodstuffs in the stores, warehouses, mills and plants of the destroyed cities, and the loss of practically all transportation facilities, our people for the first time in our history will know what real hunger is.

In the meantime our country will be at war but this time we will not be the grubbasket for nations fighting on our side, nor the arsenal of democracy. Instead, for months to come we will be fortunate if we can distribute our lean supplies of food among our own people by any enforceable means of rationing that can save thousands from starving to death and can prevent whole armies of desperately hungry mobs from turning to wholesale pilferage and robbery. With the loss of large stocks of military equipment when the large army posts, arsenals and armories are destroyed, we will also need for ourselves all the arms and ammunition that can be gathered anywhere in order to guard our continent against the possibility of an airborne invasion.

Naturally, the public will ask and has a right to be told why it is that our army, our navy and our air force are not prepared to save the country from being threatened with a calamity so heartsickening as this. The public rightly assumes that the mission of our armed forces is to protect our country from its enemies, and surely protection will never be more needed than on that day when atomic bombs start the destruction.

Our army, even with its Lewis, Knox, Benning, Bragg and other large forts and establishments blasted into ruins from atomic bombing, with its troops scattered about tent camps in the field, a regiment here and a battalion there, most of its military stores destroyed, its personnel scrambled—our army, yes, even in the state of confusion into which it will be thrown by the sudden onslaught of atomic warfare, can be counted upon to pull itself together under the discipline of its leaders and repel any early attempt the enemy might try for an airborne invasion. But definitely what our army cannot do is to prevent enemy planes and rockets, bearing atomic bombs and incendiaries, from destroying our important cities and large industrial plants, burning to bare hills the regions of wheat and forest in the West, knocking into pieces our great river dams and immobilizing our mines. It simply is not within the capabilities of our army and its types of weapons to defend the nation against special acts of war of this kind.

Never in the history of the world has there been a navy equal in strength to the present American navy. Indeed, in tonnage of modern surface ships it is rated stronger than the navies of all the other powers put together. Nor is this commanding rank in surface ships likely to be lost soon, for great fleets of ironclads cannot be hammered together in one year, nor even in five. In fact, no nation is known to be building or planning to build a fleet of capital ships strong enough to challenge our navy to a decisive battle in the open sea.

Because of our overwhelming sea power, when the next

war does begin our navy will have the wilderness of the waters of the whole world for its area of operation. It can protect our merchantmen and the merchantmen of all friendly nations and keep their cargoes moving toward our shores through all the lanes of the seas. Meanwhile, it can sweep from the seas any surface fighting ships and merchantmen of the enemy. It can break up, certainly, any foolhardy attempt the enemy might make to send an invasion army to our mainland and it can send the ships of his convoy to the bottom with all on board. It can deal with enemy submarines that wander into our waters and into the waters of the nations friendly to us. But notwithstanding its uncontested supremacy on the sea our navy, no more than our army, can prevent the enemy from sending, from hidden bases, his planes and rockets across the ocean to our continent.

The planes of our air force at bases along our coastlines and boundaries will be able to rise quickly into the sky and challenge the approach of any armada of enemy planes. Moreover, the offensive power of our air force is tremendous. Its planes are modern and type for type, we must hope, will be the fastest and most dependable planes in the world. This means that there will not be any one-way fog hanging off our shores, such as hung over Europe during the early days of World War II, which can prevent our planes from taking off from their bases with loads of atomic bombs of their own. It is a sure bet that our air force will destroy every crowded large and middle-sized city in the enemy territory, wreck all of the enemy's port facilities, all of his large river dams,

all of his large industrial establishments whose buildings have not been widely scattered or built underground and put out of commission all of his important mines. It can destroy his plants and other facilities for making atomic bombs. But with all this, our air force cannot be depended upon to find and destroy the enemy air bases that are dispersed among dozens of small, well-camouflaged fields, nor to find and destroy the hundreds of acre-size rocket bases hidden in the deep forests. Unless it finds and destroys these fields and bases our air force cannot prevent the enemy's bombs and incendiaries from reaching our continent.

Our air force may, and probably will, be able to grab the initiative and continue to hold over the enemy what is known as air superiority. But air superiority has never meant that one nation can absolutely prevent planes from the enemy nation coming within its own territory. It is particularly true that a plane of great speed flying at high altitude can cross from one side to the other almost at will, regardless of which nation claims superiority in the air. If forced into an exchange of savage destruction with the enemy, therefore, the best that can be hoped for from our own air force is that it will be able to reach the enemy in his homeland with more planes and pour more destruction upon him than he will be able to return. But the blasting of a thousand cities into nothingness in the territory of the enemy is not going to save a hundred of our own large cities and perhaps six or seven hundred smaller cities from being destroyed by bombs. Nor will the killing of thirty or thirty-five million civilians by bombs dropped

by our air force save twenty-five million of our own civilians from meeting death in the same horrible way.

As sighted antiaircraft guns have been made all but obsolete by the fast jet planes, our nation and other nations will naturally be striving to create radically new types of air defense weapons. Among these new weapons it is probable that there will be a missile controlled by radar or some other kind of beam, which can be guided through clouds or darkness toward an enemy plane, even toward a rocket splitting through the skies at supersonic speed. Were it within the bounds of human ingenuity to create a ray-guided missile that would never miss its target, no matter how fast that target may be streaking through space or how many intercepting devices the enemy might employ to interfere with the piloting ray and deflect the missile from its appointed path, then, of course, such missile would be the end of bombing planes and rockets. This would be true not only in the case of enemy nations but also our own country and our allies, because there could be no hope that the mechanical principle of the missile could long be kept secret by any one nation from the others. When our Department of Defense requests no further appropriations for the construction of bombing planes and rockets, and asks for authority to inactivate all strategic bombing groups, that will be the day our inventors, or inventors in some other country, will have succeeded in producing a ray-guided missile or some other type of air defense weapon that spells the end of both bombing planes and rockets.

But the chances are a million to one that no such fan-

tastic missile will be created in this century, if ever. It has always been the history of weapons discharged by explosives that the more mechanically efficient they become, paradoxically, the greater are their percentages of misses to hits under battle conditions as compared with the older, simpler weapons. This is true because targets have increased in elusiveness faster than mechanical imperfections can be overcome and human errors in handling a weapon can be eliminated. For example, during the recent war we had in our Browning machine gun, Browning automatic rifle and Garand semiautomatic rifle three of the most accurate and dependable automatic and semiautomatic weapons ever invented. Any one of these three weapons on the target range can put bullets through a cloth target hour after hour without a miss. Yet on the battlefields of Europe these three weapons among them made at least twenty-five thousand misses to every German they fatally hit! In contrast, the American-made long barrelled flintlock of the Revolutionary War won its fame because of the few misses it did make. Furthermore, any weapon that is to depend upon operation or control by a ray will always be in danger of being rendered completely worthless by having its ray neutralized, or at least interfered with, by a counteracting device in the hands of the enemy. That is what happened to the Germans' magnetic underwater mine during World War II. Brought out as a secret weapon, its initial success was tremendous, and Hitler was throwing one fit after another in wild rejoicing that the weapon would be the end of British shipping. Then the British started equipping their ships with a de-gaussing ap-

paratus. This British invention, born of desperation, made a dud of the magnetic mine, and it passed out of the war picture as quickly as it had entered.

In spite of all this, let it be supposed that some day there will be developed an air defense missile of such lightning speed that it can overtake the fastest plane or rocket, and of such fantastic accuracy that it will never miss its target. Could this mechanical falcon be depended upon to prevent atomic bombs from being dropped upon our crowded cities and other major targets? The answer might be yes for a time, but eventually the enemy's technicians would probably adopt the design of this missile of matchless speed to a carrier for their own atomic bombs.

This is not to protest against the development of superweapons, but only to urge that we scrutinize critically all claims that, before the next war, there will be weapons which will never miss their targets and which can be trusted one hundred percent to prevent atomic bombs from reaching any target in our country. The citizens of the large, crowded cities, who presently are grasping for any word of hope about the atomic bomb, are in danger of being misled by such wildly exaggerated, irresponsible claims. Once misled into believing weapons can save them, it will be difficult to get them to turn a hand in helping to develop measures for civilian atomic defense.

Although it is true that today our three armed services combined do not have the power to provide adequate protection against atomic bombing, it is known that every resource of science, of research, of ingenuity and inven-

tion is being brought to bear on the problems of devising the means for effective defense. Our armed forces are being greatly enlarged, their training modernized and special skills developed for the handling of new types of weapons and equipment. But this is not enough; it cannot be expected that every corner of our land can be made secure by the armed services alone. To meet the threat of atomic destruction the efforts of our military forces must be supplemented by the creation of an adequate civilian defense.

So far there have been put into practice almost no measures for civilian atomic defense that deserve to be called such. The warning sirens, air raid shelters, corps of volunteer fire fighters and stretcher bearers that the cities are presently being told to hurry to readiness are nothing more than measures borrowed from the TNT-bomb defense employed in London during England's darkest days of World War II. How woefully inadequate will be these London measures to deal with atomic bomb defense should be apparent from the fact that a single atomic bomb of a size of those already used in test explosions has within it more power than all of the thousands of tons of TNT bombs that were dropped upon London during the six years of World War II. To equal the power of this one atomic bomb in standard TNT bombs would require a load of standard TNT bombs that would fill a column of military trucks stretching on the highway from New York to North Carolina. To make one other comparison, the model A-bomb is as much more powerful than a TNT bomb of the type that was more frequently dropped upon

London as that bomb was more powerful than an ordinary stick of dynamite.

Indeed, the incredible power of the atomic bomb puts to shame the idea that because certain measures of civilian bomb defense were, on the whole, successful against the TNT bomb these same measures should also be adequate to protect us from the threat of the atomic bomb. Had the Londoners of 1939, before the first TNT bomb was dropped upon their city, anticipated it as something like a miner's stick of dynamite, to be defended against, when it fell among street crowds, by crouching behind parked automobiles, or by ducking into doorways, they could not have been one bit more absurdly underestimating its power to harm them than are those among our own people at the present time who have an idea that air raid shelters, warning sirens and other measures borrowed from TNT-bomb defense will be sufficient to protect us from the atomic bomb.

After the bomb of Hiroshima was exploded the question was asked as to how long it might be before another nation might be able to put together a similar contrivance and reach parity with us in manufacturing it in stockpile quantities. The answer, a consensus of opinion gathered from many persons, put the time at 1955, ten years after Hiroshima. Admittedly some of the figures that went into the composite estimate probably were no better than rough, inexpert guesses. But many of the estimates were from persons qualified to evaluate intelligently the time which might be required for a nation not in our confidence to assemble the necessary scientific knowledge, to build

the first plant and get it operating dependably, and after that to build additional plants and get quantity production rolling on a basis limited only by the manpower, materials and money this nation could afford to give to this one project of war preparation.

The sixth of these ten years has already passed, and there has been no sustained hopeful news from any source to warrant moving the date line further into the future. To all appearances at this moment 1955 is still the year when we may have to admit that our stride in the production of atomic bombs is being matched by another nation. After that time, other things being equal, in a war between our nation and another nation armed with an ample stockpile of bombs the advantages of battle will lie with the nation that has made as much progress in the development of civilian atomic defense as it has in developing the offensive powers of the weapon.

The four years remaining of the ample ten we once had do not leave us with much time in which to build an atomic defense, yet we can make these four years count preciously if we can ever be stirred to that effort. If we begin this very year and month upon projects designed to accomplish adequate civilian atomic defense, to the exclusion of every other project that can reasonably be put aside until brighter days ahead, we can hope to have at the end of 1955 an atomic defense that will save us from harm in any catastrophic proportion. We can accomplish most of this security in eighteen months, if we are willing to put forth to this end an effort equal to the splendid might of effort we put forth as a nation,

during any period of eighteen months, toward winning the Second World War.

Before atomic defense is taken up a chapter is being interposed. It will attempt to explain in simple terms the fundamentals of atomic energy. Of course, nothing will be said about the atomic bomb that our government has not already seen proper to release to the public. In truth, no claim is made to any knowledge on the subject beyond that which comes from government sources of information, properly released, or which can be found in books and magazines available to all.

2

POWER FROM THE ATOM

PLAIN water is as good a substance as any with which we may begin to explain atomic energy. Suppose we start with a pint of it.

If a pint of water is poured in exactly equal amounts into two containers, in each there will be one half pint, or eight ounces. If the water in one of these containers is then thrown away, and the water in the other exactly divided between the two containers, in each container there will be four ounces. If this performance were kept up continually the amount of water left to be divided between the two containers would be two ounces, one ounce, one half ounce, and so on. When the amount of water became too small to handle, one could, nevertheless, keep on dividing it mathematically with the aid of a pencil and paper. Soon there would be left less than one one-millionth of an ounce, less than one two-millionth of an ounce, and so on. Like the frog that found it could never get to the end of a log by decreasing each succeeding hop by a half of the length of the one taken before, so would a man trying to divide a pint of water find that, mathematically, he could never get the amount down to absolute zero.

Thus, if a quantity of water could, by physical means, be divided accurately many times, the original amount would eventually be reduced to a single tiny cluster of atoms known as a molecule. This molecule could not be divided and the substance keep the form of water. The water molecule consists of three atoms of which two are hydrogen and one oxygen.

A pint of water, then, is composed of countless molecules, each a cluster of two hydrogen atoms and one oxygen atom, one cluster exactly like another, and these molecules are so small they cannot be seen with the naked eye, nor even with a powerful microscope. The atoms of hydrogen and oxygen are held together in each molecule by a strong force acting like magnetism among them, but by various means available to the chemist they can be compelled to break apart. When this is done with any given amount of water and all of the released hydrogen is caught in one container and all the released oxygen in another, it is found that both substances are gasses, invisible and very light, neither one having any resemblance to water. But if the contents of one container are poured into the other container, each two atoms of hydrogen will reunite with one atom of oxygen, forming a molecule of just plain water.

Instead of using water for the experimental division, suppose another ordinary substance, salt, is taken. If divided again and again in the manner described for water, a pint of salt would at last become reduced to a single salt molecule. Beyond that the division could proceed no further and the substance remain salt. The salt molecule

is made up of two atoms, not of three as in water. One is the sodium atom and the other, the chlorine atom. Like the atoms of the water molecule, or like the atoms of any other substance, the atoms of the salt molecule have great affinity for each other, but by means available to the chemists they can be compelled to break apart. When this is done the one, sodium, is a silver-white metal, and the other, chlorine, is a greenish-yellow highly poisonous gas.

When a man sprinkles a dash of salt over food on his plate he never considers that he is about to put into his stomach billions of atoms both of metal and poisonous gas. Yet he should have no fears, because so tenaciously do the pairs of sodium and chlorine atoms cling together in the salt molecules that there is no danger of their becoming free particles in any quantity. If they should ever break apart, then, of course, the man would be in trouble.

Hydrogen, oxygen, sodium and chlorine are all simple substances. By this it is meant that a mass of each is composed of only one kind of atom. Within recent years scientists have increased the known number of these simple substances, or elements as they are usually called, by the synthetic creation of several new ones, but before that time there had been identified in nature a total of ninety-two. Of some of these ninety-two elements everything of our natural world, whether rock, soil, ocean, sky, plant life, animal life or human being is composed. They are seldom found in nature as pure substances, however—most of them, in fact, never—but are combined with one another in various combinations to form the soil, rock, wood, grass, oil, sugar, leather, rubber, paint, glass and all

the thousands of other compound substances we see about us. Furthermore, as illustrated above by water and salt, when two or more of these ninety-two elements are combined to form the molecule of a compound substance, the chances are that the substance has no physical resemblance whatever to any element composing it.

But by smelting, refining, precipitating and various other processes available to the chemists and metallurgists, all of the elements can be separated from their compounds. After this has been done, however, only with difficulty can most of them be kept pure. Given a chance, one of them will unite with one or more other elements to form a compound substance. A piece of iron, for example, if not protected with paint or oil will, upon exposure to the oxygen in moist air or moist soil, form ferric oxide, commonly known as rust, in which two atoms of iron unite in a molecular cluster with three atoms of oxygen.

With these few brief facts from elementary chemistry to serve as an introduction to the subject, an attempt will now be made to explain the elementary principles of atomic energy to the layman.

Almost all energy that keeps things moving on this planet of ours can be traced to the sun. It is therefore called solar energy. The molten sun, glowing with an internal heat hundreds of times more intense than the heat on the earth's surface, sends its rays to us across the cold celestial spaces as it has been doing for billions of years. As these rays strike the earth some of them are immediately radiated, some are transformed into heat and the rest absorbed in other ways. Every living thing,

whether plant, animal or human being, owes its life to this light from the sun.

A field of wheat which has grown from sprouts to stalks of golden ripeness in a few months' time can catch fire from a carelessly thrown cigarette and become a roaring tornado of smoke and flame. Now the question is, from whence comes the energy that, after a few months of vegetable growth, can produce a fire with flames reaching into the skies? The answer is solar energy, the energy sprayed upon the field from rays of sunlight and absorbed into the stalks of wheat.

Similarly, but not in a single season, a forest is grown, and the energy stored within the tree from the sun can be used as firewood, or it can be consumed in a devastating forest fire. The coal which furnishes fuel for most homes, offices and industrial plants, is decayed vegetation which millions of years ago was laid down as coal measures in hot, steaming jungles. All of the fuel power in a lump of coal is energy that was absorbed from the sun during the process of vegetable growth. So, too, oil pumped from the ground was once vegetation, and all the energy released from it, whether through burning it as fuel oil or exploding it as gasoline, is solar energy that was stored millions of years ago.

The horse eats grass and the energy stored in the grass from the sun is absorbed into the tissue of the animal, some of it to be transformed into heat and some of it into motion. A coyote does not eat grass because it is not equipped with the kind of digestive organs that can absorb energy directly from grass. The coyote, instead, must

catch a rabbit, and the energy in the meat of the rabbit which the rabbit got from the grass, and which the grass in turn got from the sun, is passed on in the meat to the coyote. But neither the rabbit (the grass eater) nor the coyote (the meat eater) can get any energy directly from the sun. The energy comes to both of these animals indirectly from the grass, which like all plant life has the ability to absorb energy directly from sunlight. It is not only impossible for the animal to manufacture its energy directly from sunlight, but the sun when it is too hot may actually slow the animal down a bit. Illustrative of this is the story of a man in Texas, who says he once saw a coyote chasing a jack rabbit, and so very hot was the day that both coyote and jack rabbit were walking.

Man, along with the grizzly bear and crow and a few other creatures with mixed appetites, has a digestive system which can take energy both from vegetation and meat, but man can absorb energy directly from sunlight no better than can horse, coyote or rabbit. It is a shame, too, that he cannot. If he could, these are the days when he surely would rather be recharged with energy by standing in the sun for an hour or two than pay $1.25 a pound for beefsteak.

The sun shining upon the ocean daily evaporates billions of gallons of water. Wind moves the vapor clouds in from the ocean upon the continents, abundantly in some places and hardly enough in other places, and the condensed moisture falls as rain or snow. The water soaks into the ground and the excess runs away as rivulets, then streams and finally as rivers, to rejoin the ocean

whence it came. Where one of the rivers flows over a precipice or where its flow is rapid, a dam can be built and a hydroelectric plant installed, and the harnessed power of the water can be carried over high-tension lines to cities many miles away. But the energy still is solar energy, derived in this case not through the chemistry of fuel or foodstuff, but from the gravitation of water which the sun has lifted from the ocean.

The wind that drives sail-rigged ships across the ocean and sportmen's yachts up and down the coasts, and whirls the screeching windmills out in Wyoming and western Nebraska is caused by air flowing from a region of high pressure to one of low pressure, and the pressures are caused by the sun.

All of this energy, whether it comes to us through fuel, food, rain or wind, starts with the sun. From that molten mass, glowing with an intensity of internal heat beyond anything we know about here on earth, the sunlight is thrown off. The rays travel across the millions of miles of space between the sun and the earth in less than nine minutes, a rate of speed so fast that it has been estimated that, neglecting resistance from the air, if a ray of light were a bullet shot from a pistol held horizontally in front of a man, it would repeatedly circle the earth and hit the man holding the pistol seven times through his back before his body could fall to the ground.

So nearly completely, in fact, does every motion here on earth depend upon energy from sunlight that it is difficult to name one that does not. There are, however, a few. For instance, an earthquake such as the one that

shook San Francisco to the ground in 1906 can be very destructive to life and property, and yet so far as is known an earthquake does not owe its power to the sun. At Pagosa Springs in Colorado and at a few other places homes and offices are heated by water piped from springs which boil from the bowels of the earth. This heat from the center of the earth is a form of energy that cannot be called solar energy. The fisherman who lets his skiff move in and out of the harbor with the turn of the tide is making use not of solar energy but of lunar energy, the power from the moon which causes the tides of the seas. A project started a few years ago for harnessing the tides on the Maine side of Passamaquoddy Bay is interesting because, if ever completed, it will be the first successful important attempt to obtain electrical power from lunar energy.

But of the forms of power that, so far as is now known, owe nothing to the rays of the sun, the greatest of all is one of which, strangely, no serious notice was ever taken until about fifty years ago. It was just before 1900 that a small group of scientists became interested in uranium, one of the heavy elements, observing that apparently it was radiating an energy from within itself. A short time later the same characteristic was found both in thorium and radium. It is now known that these three heavy elements and some others possess a strange quality called radioactivity, the spontaneous emission of certain rays of light caused by the disintegration of atoms within the element. The presence of these few radioactive substances in nature made scientists wonder whether inside the atoms

of all matter, a chip of rock, a splinter of wood, a drop of water, there might not reside a stabilized form of energy, one not put there by the rays of the sun as energy is put into vegetation. If this were true, and a means could be found for breaking open atoms and releasing this energy, as fire had been found to release solar energy, the world would have a power far greater than that which is obtained from the burning of wood or coal. Certainly this was one of the most venturesome ideas ever to start prodding the minds of serious men.

What for several years had to exist as only a daring theory became, in 1919, a proven fact. In that year, after many years of frustration in the attempt, was accomplished the first successful effort to break open an atom by mechanical means. When this was done, just as the scientists had been hoping and expecting it might, the ruptured atom turned loose into space an amount of energy out of all proportion to its infinitesimal size.

The atom having been successfully split, the efforts of the scientists, encouraged by this success, were intensified further toward uncovering the mysteries inside the minute particle. With great strides work and study progressed right up to the beginning of World War II. But with the coming of the war, the free exchange of scientific ideas between all countries of the world unhappily had to cease. The work of the several national groups became cloaked in secrecy. In addition, some of the scientists had to leave their laboratories and classrooms to take assignments in plants and there do the work that normally should have been delegated to engineers, because among the engineers

there was as yet none trained who could give mechanical shape to the new knowledge the scientists were uncovering about the atom. In the opinion of many scientists, the period of the war set back by many years the development of atomic energy.

But now that the nuclear scientists have been released from their war assignments at which places, understandably, most of them were never very happy, they are back at work in their special fields of exploration and evaluation, formulating the laws of atomic energy. Although they cannot work with the complete freedom of discourse and action they enjoyed before the war, at least they now have more freedom than they had when they were regimented into the war machine. By all reports the scientists exploring the fields of atomic energy are making good progress.

Although many theories about the atom are still in dispute among the scientists themselves, in general there is almost unanimous agreement that the atom consists of three principal components, the electrons, the protons, and the neutrons. The existence of several other particles may later be agreed upon among the scientists, but if laymen can grasp the theories of the three named above, they will be close enough to a correct understanding of the functioning of the atom to be able quickly to adjust their ideas to any corrections in formulas that later may be necessary as a result of more recent discoveries and evaluations.

According to the present view, then, the construction of the atom may be compared to the construction of the heavenly solar system. At the center of the atom and com-

parable to the sun is the nucleus, and in the outer space at a relatively great distance from the nucleus revolve, with incredible speed, the electrons, the number of which for a particular atom depends upon the element—iron, oxygen, sulphur, or what not—to which the atom pertains. These electrons can be compared to the planets of the solar system. Also, just as in the solar system the sun is larger, much larger, than all of the planets put together, in the atomic system the nucleus by weight is very much heavier than the sum total of all the electrons in the same atom.

The nucleus of the atom—which again let us compare with the sun of the solar system—is not a mass of uniform density but, among other particles, contains one or more particles called protons, each one very heavy as compared to an electron, and the number of them in a particular atom depends upon the element to which the atom pertains. Hydrogen, the lightest of the elements, has at its nucleus a single proton; helium, next lightest, has two; lithium has three; and so on up the atomic scale to uranium, which was the heaviest of known substances until scientists were recently successful in creating new elements by artificially putting into atoms more protons than are found in nature in any substance. Uranium has ninety-two protons in its nucleus.

And now comes one of the most interesting facts of all about the atom. There are exactly as many protons in the nucleus of the atom as there are electrons revolving about it, and each proton controls one specific electron and no other. To continue comparing the atomic system with the

solar system in this respect would be like saying that inside the sun are a number of heavy masses, each having the sole duty of controlling one of the planets revolving about the sun.

When one grasps the fact that the nucleus of an atom of any particular element has the same number of protons as there are electrons circling about the atom, the elementary nature of electricity, which one must understand before one can understand atomic energy, is brought to light. Each of these protons carries in it a positive charge of electricity, while each of the electrons carries a negative charge of electricity; or, rather, each electron *is* a negative charge of electricity.

Electricity is described as consisting of two kinds of charges, one of which has been named *positive* and the other *negative*. All who have worked with or examined an electrical battery, such as a storage battery in an automobile, know that it has what is called a positive pole, marked for identification with a positive (+) sign, and a negative pole, marked with a negative (−) sign. They know further, no doubt, that if a wire from the generator is attached to the wrong pole the battery will not function properly. Also, those with that much knowledge of electricity probably have seen, or have at least heard, that two positive charges of electricity repel each other, as do two negative charges, but a positive and a negative charge have attraction for each other, and get along perfectly.

A positive charge stays at home in the proton of the atom, while the negative charge, the electron, circles round and round it. If by some disturbance the negative charge,

the electron, is knocked out of its orbit, it flies off into space, seeking another proton. It is only while an electron is travelling from the proton of one atom to the proton of another atom that its force is manifest. We then know it as *electricity*.

It is not particularly difficult to knock electrons loose from atoms and thereby release electrical energy. The process can be seen taking place in the skies during electrical storms. And for more than a hundred years now electrical engineers have been artificially knocking electrons loose from their positive charges, or protons as we now call them, releasing electrical energy. This is the principle of the storage battery, the dry cell battery, the generator at hydroelectric plants and of every other device or piece of machinery that produces electricity. Make any machine or devise by which electrons can be knocked loose from their positively-charged protons, and electrical energy has been created.

The electrons knocked loose from their protons prefer certain substances to others for their paths while seeking other positive charges. The metals, particularly, are rated good conductors of the stray electrons, but the metals vary remarkably among themselves in this quality. Copper wire is a much better conductor than iron wire, and is preferred for telegraph and high-tension lines.

After the scientists working with the atoms had learned that each atom has a nucleus about which revolve the electrons, the atom might have remained a comparatively simple affair had inquiry ended there. But this knowledge did not explain all. A further search into the atom was

necessary to explain, among other things, how it was that the positively-charged protons could remain held together in a cluster in the nucleus despite the fact that it is the nature of positively-charged particles mutually to repel one another. This search led to the discovery of the neutron, a particle believed to rest nearer the center of the atom than the proton does. In weight a neutron is about the equal of a proton, which is said to be more than eighteen hundred times heavier than an electron. The discovery of the neutron was made in 1932, and is accounted one of the great steps in the exploration of atomic energy.

There is no electrical force connecting protons and neutrons, as there is the protons and electrons, and there is no insistence, as in the case of protons and electrons, that the protons and neutrons must exactly match in number in the atom of a particular substance. But while no electrical charge exists between protons and neutrons, nevertheless there is a strong attraction between them, and among the neutrons themselves, which acts to hold both protons and neutrons tenaciously clustered in the nucleus. This force, however, is not an electrical force.

There are several kinds of forces. There is the force of gravitation, which causes objects to fall to the ground from a higher level. There is magnetic force, which when present in a piece of steel can lift a smaller piece of iron from a table and hold it suspended against the force of gravity. Either by cohesive attraction or by adhesive attraction, or by the combined action of the two, the upward flow of sap in a tree is assisted, kerosene rises in the wick of a lamp and rain water clings in drops at the

edge of a roof, both forces in these instances acting against the law of gravitation. There is a force of electricity, described above, which everyone knows can run up a wire as fast as down, apparently not in the least influenced by gravitational force. With these several kinds of forces already known, it does not seem unlikely that another might be discovered.

Now back to protons and neutrons. It has been found that these particles are held together in the nucleus by a force previously unknown, and if by any means the neutrons can be knocked apart from the protons and from one another in an atom, this newly found force is released, not at all unlike the way in which the electrical force is released when electrons are knocked apart from the protons. But this newly found force in an atom is hundreds of thousands of times stronger than the electrical force residing in the same atom. Its popular name is *atomic energy*, but as it comes from the nucleus of the atom it is also called *nuclear energy*.

All these thousands of years since man first began burning wood and other combustible substances, releasing solar energy from them, there has resided in the atoms of the same substances another kind of energy which, if it were released, could give millions of more units of power than that obtained from solar energy. For example, a two-pound chunk of coal burned and converted into electricity could not produce enough current to keep lighted a 25-watt bulb more than a few hours, but the nuclear energy in a two-pound chunk of coal, if it were released, could keep the same bulb glowing for billions of hours.

Indeed, a bag of it, such as a boy could carry on his back, could produce all the power required to light and heat all the homes and offices and turn all the wheels of machinery in the United States for a whole year. This, to be sure, is a staggering thought and reminds one of the story of the placer miner who has washed down a pile of gravel to collect a few grains of gold dust, and is later told that in the tailings which were washed away were diamonds a billion times more precious than the gold he recovered.

There follow an explanation of *chain reaction* and comment upon the possibilities of using atomic energy for commercial purposes.

In the game of bowling the ten pins are placed in such a manner that both skill and chance play a part in knocking them down. At one time, when the ball strikes a certain pin in a certain way, all the ten pins will tumble; but at another time only some will fall and the rest will remain standing. The two different results are possible because the pins are spaced too far apart to make a chain reaction certain no matter where the ball strikes. If, instead of arranging the pins in the manner the rules call for, they were placed in the form of a ring with only a half-inch of space between one pin and another, any pin of the group in upsetting and touching another pin would cause all to tumble. The same would happen if a thousand pins instead of ten were set up in a single ring with only a small space separating one pin from another.

So it is with a mass set up for atomic explosion. Before the mass becomes explosive by chain reaction its atoms

must be *packed* in such a manner that a chain reaction can take place among them. Once the bomb is ready, all that is required to explode it is a means for exploding a very few of the tiny atoms. This is accomplished by bombarding the mass with neutrons, an action comparable to the spraying bullets from a machine gun. One of these neutron bullets strikes the nucleus of an atom and ruptures it, causing it to give up its neutrons, some of which fly off with tremendous speed and power, becoming neutron bullets themselves, and in turn strike other atoms, rupturing them, and causing more bullets to fly off. Once started, this chain reaction continues until all the atoms of the prepared mass have been struck with neutron bullets and exploded. In point of fact, the explosion is a series of explosions, but so fast do they take place that to the human senses it seems to be a simultaneous performance.

This is a crude way of explaining the explosion of an atomic bomb, but of course in practice the process hardly is as simple as that. For obvious reasons the means for packing the atoms so that a chain reaction will take place must be a secret from laymen at present. But we should not complain about it. It is sufficient for us to know that atoms of certain substances can be set up in such a manner that a chain reaction will take place among them and when a striker has been released atomic energy is set free. This has already been done several times. The first explosion took place on the sands of Alamogordo, New Mexico, and the next at Hiroshima.

In an atomic bomb the process of chain reaction acts with lightning velocity, because a fast chain reaction is

necessary for a detonation. But for commercial purposes—to furnish power for ships, planes and industrial plants—we could not use a mass of atomic fuel that shoots its full amount of power away all at once. For commercial purposes there is required a type of atomic fuel which will disintegrate by *slow* chain reaction. There is no insurmountable difficulty in producing such fuel. In fact, it was a slow chain reaction process in uranium and other radioactive substances in nature that first brought atomic energy to the attention of the scientists.

Now that atomic energy has been discovered and found to be millions of times more powerful than solar energy, which has served mankind these thousands of years, naturally the big question is whether atomic energy will replace solar energy when it comes generally into use. The answer is that it will not. To explain this answer there must be stated one of the fundamental laws of nature, the law which states that no more power can be obtained from a stable system than the work put into it. This law, when applied to atomic energy, means that no more power, great as that power is, can be obtained from a mass of atomic fuel than that which is represented by the work required to set up the atoms in such manner that a chain reaction will take place among them.

A thousand tumbling bowling pins would represent a lot of noise and other forms of energy, yet if the total amount could be measured it would be found no greater than the amount of work which was required of the pin boy to set up the pins in such a manner that they could be toppled, one and all, by chain reaction. So it is with

a mass of atomic fuel. It can never release more energy than the amount of energy that has been required, whether from water power or the burning of coal, to pack the atoms in such way that a chain reaction will take place among them.

This fact answers the question of those who have been asking if it is possible for one of the long-haired scientists to poke into something one of these days and start into motion a chain reaction that will cause a chunk the size of the moon to be blown out of the earth. The only mass a long-haired scientist or anyone else will ever be able to explode by chain reaction is one that has had its atoms packed in such a manner that the explosion of one will cause the explosion of another. That will require an amount of work equal to the effect produced.

Now comes the most important question of all. What commercial value will atomic energy ever have for us if, to manufacture atomic fuel, we must rely on the solar energy derived from burning coal or hydroelectric power? It is readily seen that airplanes which can remain in the air for weeks and submarines which can cross the widest ocean under water have war values that offset all other considerations. But how atomic energy will be used for commercial purposes is not readily apparent. We must pause to consider this problem because in a few years our lives are likely to be largely ruled by atomic power. The answer is that atomic fuel can be transported at negligible cost and stored for unlimited periods for future uses.

The waterfalls and gushing streams of Oregon, Washington, Idaho, the Rocky Mountains and the Appalachians

have among them enough energy to furnish the whole of the United States with all the requirements for its light, heat and power, if every unit of this energy could be harnessed, transported and stored. But there is a limit to which high-tension lines can carry electricity from hydroelectric plants. They can carry it a good many miles, but because of leakage along the wires a point is reached eventually where trying to carry it further would be too expensive for ordinary uses. Hence, instead of using electricity from water plants, most of the cities of the East, South and Central states are lighted with electricity generated at local plants burning coal. And in only a very limited way can electrical power be stored for future uses; for instance, all the electricity coming into a home at any instant is electricity which has been generated at a plant less than a second before.

All of this may be changed in a few years. Much of the water power from the waterfalls of our mountainous regions can be used for manufacturing atomic fuel. And atomic fuel can be made at the mouth of the coal mine. Because of its negligible weight it can be transported at almost no cost to the cities throughout the country and transformed as needed into electricity. When that day comes a factory can be located on the flat lands of Oklahoma or Florida and have the same advantage of power as a factory located in a region of waterfalls or a region of coal mines. The sources of raw materials, nearness to markets, climate and other factors, rather than nearness to power potentials, will determine the locations for most of the factories of the future.

Once the business of manufacturing atomic fuel for commercial purposes gets under way, the change-over to its use should not be difficult. Not so many years ago the electricity for many a small city or town was produced at a local plant which used coal or cord wood to feed the engine that turned the generator. Then transmission lines which were brought in from hydroelectric plants and large steam plants took over the work of the local plants, and few people living in a town or small city knew when the change-over took place. Something like that could happen when atomic fuel replaces the transmission lines.

The plants manufacturing atomic fuel will be located in regions of water power and coal. From these places the manufactured atomic fuel can be transported anywhere at negligible cost for transportation. A plant for converting the atomic fuel into electricity will be built at the edge of a city, and when ready to go into operation it will take over the work of the cross-country high-tension lines. In homes and offices not a single wire need be changed, not a single light bulb replaced. In fact, unless there is some local politician who insists on making the day of the change the occasion for a speech, probably no more than a few people living in the city will know about it. All the great things in life have a habit of coming with quietness and modesty when they do come, and atomic energy for commercial purposes probably will be no exception.

The greatest difference will be the cheapness of electric current as compared with present prices. That will make electricity useable not only for lighting homes, but also

for heating and cooling them. At the factories electricity can be used both for power and furnace heat. The tall smoke stacks now standing in the cities, belching clouds of black smoke and filling the air with soot, dust and injurious gases, and causing us to suffer from respiratory and sinus troubles, can come down. Everywhere the air we breathe will be as clean and healthful as mountain air. When the atomic age comes into full bloom the United States in all of its regions will be a cleaner land for all.

All this is wonderful to think about and look forward to, of course, but before our nation can do much about the development of atomic energy for peacetime purposes it must stop wasting precious time and start developing a civilian atomic defense which will save it from the destructive power of atomic energy used as an instrument of war.

3

THE PRINCIPLE OF DISPERSION

In olden times the soldiers of a country at war were the King's troops, and the size of an army was limited mainly to the number of men the sovereign could support by squeezing revenues. In consequence the soldiers, pitifully paid, equipped with battered weapons and ragged uniforms and seldom fed from the royal cooking pot, rarely numbered more than a few thousand. But times have changed in this respect as in many others. Today's army in time of war is financed by bonds, which are mortgages upon the future presumed capacity of the nation to pay. Cost, therefore, hardly imposes any restraint upon its size. Instead, the numerical strength of the army of the modern nation at war is determined largely by its total number of able-bodied men of military age. For any country this number is roughly ten percent of its population. This rule applied to the 150 million population of the United States gives 15 million as the maximum number of men we might expect to have in uniform at any one time.

There was a time, too, when a nation won a war almost solely by its combatants, with their simple weapons, de-

stroying or driving from the field the combatants of the enemy nation. The battlefield was the place where the issues of war were decided. There the bruised and bloodied soldiers out in front, hacking at the foe with their broadswords and exchanging musket shots with him at point blank, and the king with his retinue of velvet breeches peeking over the hilltop behind the battle line, were about the only persons gravely concerned with the outcome of the fighting. The tillers of the soil who lived at a distance from the battlefield were but little touched by its tidings. They were out of luck only when their strips of tenant-held land happened to lie in the path of the maneuvering armies. Then they could expect to have their crops trampled down and their geese and swine toted off, by either friend or foe, to go into the pots of the soldiers' camp-fire messes.

That day, too, has passed. The soldiers of today fight with weapons, ammunition and machinery with which only an army of industrial workers even larger than the army of combatants can supply them. Nor can modern soldiers feed themselves in the field by foraging for food along the way, as did the musketeers of the old times. In the theater of war the modern army feeds from a ration dump, the food for which another army of farmers, stockmen, gardeners, canners, packers and shippers at home must grow, process and transport. When for any reason there are interrupted the long lines of supply, pushing forward from home front to war front with a continuous flow of rations, ammunition, weapons, machinery replacements, motor fuel and medicine, the soldiers at the battle

front are faced with defeat just as surely as if the enemy had broken their lines and completely surrounded them.

The quickest means any modern belligerent has for cutting the enemy's supply lines of weapons and ammunition are by bombing raids carried deep into his territory, wrecking the factories that produce these materials, killing and harassing the factory workers. In similar manner his supply lines of food can be slowed to a trickle if crops in his homeland can be destroyed by incendiary raids, canneries and packing plants wrecked by bombing, and facilities for transportation put out of order.

All of this and related facts add up to one great and inescapable total fact, which is that in time of the next great war every important factory, plant, smelter, refinery, every mine pit, oil field, every destructible area of crop and forest, every large bridge, gigantic dam and long tunnel through a mountain—moreover every dense mass of people a nation has—will be a target for the bombing raids of the opposing power. That is the meaning of total war. It is the kind of war we can expect will be waged against us. And of course it is the kind of war we must be prepared to hand back, with something in the bargain, to the enemy.

The scope of war has not only been widened to include every person and service that contributes in any way to the efforts of war, but still another idea—stockpiling—has given to war a dimension of depth. The idea of stockpiling is that the industrial and agricultural capacities any nation has for waging war need not be limited by its current annual outputs from mines and mills, nor by its current

annual crops of foodstuffs and fibers, but by the whole of these supplemented by whatever amounts of ores, raw materials, manufactured goods, strategic imports and foodstuffs it has saved from previous years and stored as war reserves. Thus a small nation which has for many years put aside some part of its mine, factory and crop productions, and some part of its strategic imports to be held as war reserves, actually may be better prepared to fight through a war of long duration than will a much larger nation that has fallen into an unworthy habit of boasting endlessly of its great natural resources but like the proverbial grasshopper that wasted the summer in frolic and song, takes no fear of the future to lay by a store.

Our own nation was slow about adopting the idea of the stockpile as an important measure for national defense. Several years before World War II, but after the warning rumblings of that war had begun to be heard, there were individuals and groups in our country who tried to persuade the federal government to bolster national defense by means of the storage of war reserves. Finally, after much exhortation, a modest beginning was made in storing those strategic minerals which were obtained chiefly from foreign sources. But in the main the advice to stockpile war reserves was unheeded.

In the years before World War II, when our nation was desperately trying to spend its way out of the depression that had started in 1929, the billions spent upon unemployment relief and crop relief could just as well have been spent upon projects which, while accomplishing the primary purposes of relief, would have contributed to na-

tional defense through war reserve storage. During those distressful years we might have put thousands of unemployed miners at work to produce for war reserve storage vast quantities of iron, copper, zinc, lead and other domestic ores. We should have put into war reserve storage cotton and woolen fabrics, or at least bales of cotton and carded wool.

We might have packed and stored for unlimited storage life thousands of tons of sugar. We could have had tons of flour properly dried and packed in tin containers for indefinite storage life. We might have put into storage tanned cattle hides sufficient for the manufacture of all the shoes and leather equipment that the armed forces would need in time of war. Rubber at that time was a beggar on the market, and although its storage life has a limit, we should have bought and stored vast amounts of it, used these before deterioration and again replaced in a continuing cycle. Thus our national defense would not have been hampered by lack of this highly strategic material. If we had done these things we would have obtained unemployment and crop relief, and also a very large measure of national defense. But we did none of these things.

We failed to import and store adequate quantities of other highly essential products. One of these was quinine, so highly strategic, yet so low in cost. Because of this negligent failure thousands of men of the armed forces were doomed to have their bodies burnt out with malarial fever in the Philippines, in the South Seas and in Burma. Had a few thousand dollars been spent upon a reserve

stock of quinine, much of the suffering, loss of combat power, ruin of bodies and even death that malaria caused among our fighting forces could have been prevented.

What our federal government was failing to do in the storing of war reserves, the German nation under Hitler was doing at any sacrifice. During several years before the start of World War II Germany was stockpiling both metals and foodstuffs. That nation was to teach nations much larger than herself, including our own, the value of the stockpile.

Now the atomic bomb brings realization of the necessity of preparedness through stockpiling. For the huge plants required to produce atomic bombs cannot be kept secret or hidden, and certainly they are among the most rewarding targets the enemy will have. After the first day of war it is not likely that we shall have left the facilities by which another bomb can be manufactured during the rest of the war. Hanford, on the Columbia, if not levelled with bombs on the opening day of war, surely will be swept away on the deluge of water that will overswell the banks of the river when Grand Coulee Dam goes out. Oak Ridge, if not directly destroyed by bombing, almost surely will lose the dams that furnish its required millions of kilowatts of electricity. It will be the same for any other establishment built for the production of atomic bombs. Positively, the ability of our nation to destroy and cripple the enemy with atomic bombing will depend solely on the number of bombs we have in our cache on the day war begins.

And for the nations that are to become our enemies

the same will certainly hold true. We can rest assured that our air force with its fast planes, our army with its guided missiles and our navy with both planes and missiles launched from ships at sea, will be able to blast into worthless chunks all the enemy's great power dams and plants upon which he must depend for manufacturing his atomic bombs. He will have no chance to put together another bomb after the war has started. The bombs he has in his stockpile on the day war breaks out are the only ones with which he will be able to hurt us.

The idea of a stockpile of bombs adds to war a principle of preparedness in depth, gives to the nations remaining at peace, but preparing for war, an accumulation of strength. The longer the war is postponed the larger will grow the stockpile of bombs on each side. This means that the longer the war is forced to wait upon preparedness, the more terrible it will be when it does come.

Suppose that in the nation or nations that are to become our enemy the stockpiling of bombs grows ever larger, until there are more than enough bombs, after allowing for the large number that will be lost before reaching targets, to destroy all of our large cities, large dams and all other first priority targets. Having completed the destruction of these, the enemy then works down through the middle-sized cities, large industrial plants, mammoth bridges, long tunnels through the Rockies and the Cascades and on to a long list of secondary targets, and still has left a considerable stock of bombs. The question then is, on a target how small would the enemy be willing to spend an atomic bomb?

Obviously a pilot would never attempt to bomb a farm house, no matter how plentiful his country's cache of bombs. Hence the millions of people living in rural homes will be in no more danger of being killed by atomic bombs than they now are in danger of being hit by comets. But a village of 1000 population—would the crew of an unopposed plane think of dropping an atomic bomb upon a target that small? Government tests indicate that an A-bomb dropped on an average village would destroy 50 percent of its population. Of the 500 killed in a village of 1000, it can be estimated that 10 per cent would be potential soldiers and 20 per cent workers or potential workers in war industries. That, in cold-blooded language, gives a total killed of 150 people whose lives were important to the war effort. This small number certainly would not be a rewarding target for an atomic bomb costing millions of dollars and the labor of thousands of workers and technicians.

Assuming that the enemy has an ample stockpile of bombs left after the large targets have been destroyed, would he drop a bomb on a city of only 15,000 population if it has no large and important war plant? An atomic bomb striking a city of 15,000 spread over an area of average size and shape could, according to government tests, be expected to destroy about 5000 people. Of this number approximately 500 would be potential soldiers and 1000 would be workers and potential workers in war industries—a total of 1500 effectives. Again a question: would 1500 be a rewarding number?

In the recent world war the estimated cost to our gov-

ernment for each enemy soldier killed was $100,000, and there is no reason to believe that in the next war the average cost will be any less. If, in the savage kind of war for which we must prepare, the dropping of a bomb on an enemy city will cause the death of 500 potential combatants, this will be as great a destruction as fifty million dollars and the lives of many of our soldiers could cause on the battlefield. Furthermore, there would be the destruction of 1000 war industry workers, and a good many thousand other civilians would be made homeless and put to dire distress. From these gory, cold-blooded figures, it is obvious that if we can manufacture atomic bombs in stockpile quantity, and drop them upon targets in the enemy country at an average cost of not more than 50 million dollars a bomb, we can afford, after higher priority targets have been destroyed, to use one of these bombs on a city in which a minimum of 5000 civilians would be killed.

But in the work of bombing cities for the sole purpose of destroying personnel, it probably would not be worth while for either side to drop a bomb on a city unless that bomb killed at least 5000 people, of whom 1500 were potential combatants and war industry workers. If the war had not been won by bombing out of existence all of the major targets, certainly there could be no hope for its being won by attacking cities of a size that would average less than 5000 deaths. At that low figure a more feasible course of action for either nation would be to save the remainder of its stockpile of bombs to be used for the destruction of mobile targets such as troopships at sea and

concentrations of men and materials on the battlefields, of which there will be an unlimited and unpredictable number.

Generally speaking, then, a city whose population is less than 15,000, and which has no important war establishment near it, should stand in no danger of an atomic attack, no matter how plentiful the bombs in the enemy's stockpile may be, or how many good chances he may have for dropping one of them upon the city. According to the 1950 census, the number of people living in cities of less than 15,000 population, together with the number living in towns, villages and on farms, is approximately one half of the nation's total population. With the exception of the few people who may be living in small cities and towns having war industry plants or other establishments that will make them rewarding targets for atomic bombing regardless of population size, it can be said that nearly half the nation's population will be in no danger from atomic bombing, no matter what else may happen to them during the war.

Obviously, then, in atomic defense approximately half of our people are no problem whatever for the nation. Its problem is the other half who are living in cities exceeding 15,000 population. The thesis here, to be supported with figures in the next chapter, is that a city of more than 15,000 population can be rendered as safe from atomic attack as a town or village. This can be done by expanding its area, moving war industry factories to its perimeter, and by spreading homes, offices and stores apart. An enemy would not attack a city properly dispersed in this

manner, because he would not be adequately rewarded for his costly and irreplaceable atomic bomb.

So far, unfortunately, there has been no national acceptance of the fact that dispersion is the only certain defense of the cities against the atomic bomb. On the contrary, in the six years that have passed since two bombs wiped out two crowded Japanese cities, and in spite of terrible warnings of things to come, our cities have been allowed to grow larger and more congested and our rural population to shrink proportionately. Fate has been working against us from both ends. Certainly one of the most discouraging aspects of this national drift is the tendency among many civic groups to see a virtue in the mushroom growth of cities between the years 1940 and 1950 and in the plans that are being laid for even more startling increases by the year 1960. It is not a healthy sign that civic spirit and pride continue to be built entirely around the objective of making a city larger and larger, no matter how badly congested, shabby, foul-smelling, wicked and corrupt it may become in reaching its larger size. Rather the objective should be to put into operation a Burnet Plan for spreading the city out and to try to make it the most beautiful, most decent and most cultured city in its state.

The slowness in accepting dispersion as a defense against atomic bombing for the big cities can probably be explained in good part by the fact that throughout many centuries of experience in other methods of warfare, dispersion has never been accorded the military value it deserves. Indeed, on the battlefields of the past the principle

of dispersion has been repeatedly ignored, or rather there seems never to have arisen a great commander in history who gave serious thought to allowing dispersion a place among the principles of war. This is a strange sin of omission and hard to account for.

It is true that when the weapons of the battlefield were the sword and lance, reasons were good for placing infantry massed at close intervals and in great depth, in order to build a phalanx of strength at a particular point to break the opposing enemy line. But when gunpowder was introduced into warfare, bringing the musket and cannon into use and giving the soldier two weapons ideally employable against mass formations, it seems there should have come forth a military commander with the vision to see that dispersion and not mass was a defensive requirement on the new battlefield. This would limit the opposing infantrymen to aimed fire with their muskets at individuals, not at solid walls of men; and would allow the opposing artillerymen no clusters of personnel at which to sight their cannons. Such was not the case.

During the Civil War the armies of both the North and South attacked in line, men shoulder to shoulder, charging the opposing lines and even the batteries of artillery in these formations. The appalling loss of dead on the battlefields at Antietam, Gettysburg and other major battles of that war are tributes to the sublime courage of the soldiers, both the Blue and the Gray, but no tribute whatever to any commander, either North or South, who might have spared his men from such bloody slaughter by giving the infantry such dispersion laterally and in depth

that nothing but aimed fire could inflict any serious harm upon it.

In our next major war, with Spain in 1898, there was even greater need for dispersion than there had been during the Civil War. In the time between the two wars both the magazine rifle and smokeless powder had come into standard use. Hence the infantry, more than ever before, was a target that could suffer heavily from fire aimed at it in the mass rather than at individuals. But no change in tactics was made. The infantry fought the Spanish-American War in close lines of skirmishers. A yard was the proper interval between men in the line, because this was the minimum distance at which men could lie in the skirmish line and work the bolts of their rifles without rubbing elbows with one another.

By the time the First World War arrived the machine gun had been perfected, and it was ideally employable against a concentrated line of infantry. But in spite of this, no change had been made in our infantry tactics. Infantry was still being trained to deploy and fight in line of skirmishers with a yard interval between men. This meager interval of a yard was still kept for the purpose of giving the men a chance to work the bolts of their rifles, and there was no idea of allowing them dispersion for the sake of reducing casualties. If the men had been able to work their pieces at intervals of less than a yard, very likely the skirmish line would have been more crowded than it was. As a matter of fact, soldiers in 1917 were being trained to stand upon their feet in close order of squads, shoulder touching shoulder, and fire in volleys.

The idea was that there would be times when they could use this alternate method of firing to do their best fighting.

In Europe, after World War I had been raging for more than two years, and the flower of infantry had been mowed down on both sides by machine guns, both the Allies and the Germans began allowing greater interval in the skirmish line, and the Americans in 1918 copied the others. At the end of World War I our text books were rewritten to allow our infantry a normal interval of five yards in the skirmish line. But the skirmish line itself was retained, as fixed and sacred a formation as it had been in the days of pikes and harquebuses.

Soon after the First World War the attack plane made rapid development, and was seen as an effective means for delivering fire from machine guns upon skirmish lines of infantry and troops on the march. Many enthusiasts for the Air Corps went so far as to believe that the attack plane would make the infantry an obsolete arm. Among these was a member of the U.S. Congress who toured the army posts, speaking to groups of officers on the military powers of the attack plane and asking them to realign their military thoughts to acknowledge its superior place. The gentleman carried with him as his props some huge charts demonstrating an attack made by planes at an Air Corps field against assumed infantry in skirmish lines and in columns of fours on the march, the soldiers in each case having been represented by silhouette pasteboard targets of life size. The attack planes had made runs over these targets at low altitudes, spitting fire upon them from their

machine guns. Then the pasteboards were examined, and each bullet hole counted as a fatal hit, and because practically all of the targets had been hit, some of them so many times that they must have looked like punch boards, the only possible inference was that infantry was doomed before the fire power of the improved attack plane. There were many infantry officers who agreed with him.

It was the attack plane, therefore, rather than the ground machine gun of World War I that at last forced the infantry commanders to give up the ancient, sacred skirmish line, and to disperse the infantry in battle, both laterally and in depth, so that a platoon of deployed infantry no longer would offer itself as a target for any kind of unaimed fire, whether from rifle, machine gun or attack plane. It was dispersion that saved the infantry as a branch, and it lived on to give such good accounts of itself on a dozen fronts of World War II that at present no one, not even the enthusiasts of the attack plane who once were out to get its hide, has any desire to deny the infantry its share of the credit and glory of winning the war.

The examples above have all been taken from the infantry, because the picture can be more clearly drawn for this basic arm than for some of the other arms and services. But the truth is that all components of the fighting forces and all elements of command have suffered as much as the infantry once did from over-concentration.

For example, there is Pearl Harbor. There was a time many years ago, back in the days of sailing ships, when the harbor was a place where ships of a fleet could rest

at anchor safe from the attack of another fleet. During the Revolutionary War, time again a British fleet or a French fleet ran into a harbor along the Atlantic shores to avoid being forced to give battle to a fleet of superior size and gun power. Once the superior fleet had driven the smaller fleet into taking refuge in a harbor, it might stand outside and bottle the latter up indefinitely, but it scarcely dared to risk moving its wind-driven ships, one by one, through the channel into the harbor against the waiting guns of the ships inside. In those days it was a bold commander who could talk of sailing his ships into a harbor to grapple with an enemy fleet already at rest there.

When ships changed from sails to steam a fleet that was already inside a harbor still held an advantage over another fleet trying to enter, but not by so wide a margin as during the days of sail. For instance, when the Battle of Manila Bay was fought in 1898, Admiral Dewey boldly ran his fleet inside the bay to give battle to the Spanish fleet already in position there. When the admiral sighted the Spanish fleet lying off Cavite with broadsides faced for battle he stood down in column upon it. When he was within 5000 yards he ported his helm and opened fire, using his port batteries. Then he quickly turned about—a maneuver within the bay that a fleet of sailing ships could not easily have managed—and stood back, decreasing the distance. All of the Spanish ships were badly hit, and the victory over them was complete. The great lesson of Manila Bay was that a harbor could no longer be counted upon as a protection against another fleet.

But it was the development of the long-range bombing

plane that completely ruined a harbor as a place of refuge for ships. During World War II, it was learned that the boundless ocean, hundreds of miles from any shore, is the safest place for ships of a fleet to be in time of war. At Pearl Harbor our own navy had to learn this lesson the hard way.

It is not an acceptable excuse to try to explain that the disaster at Pearl Harbor could never have happened if our nation had actually been at war. When it did happen we were, to all intents and purposes, already at war with Japan. For as much as two months before that disastrous day at Pearl Harbor our fleet had been escorting transports across the broad expanse of ocean lying between Hawaii and the Philippines—a measure which only the imminence of war could have brought into use. Furthermore, we should have known even at that time that the war would not start with a formal declaration. In 1904 Japan had destroyed the Russian fleet as the first act, and the declaration of war was a detail that had to wait until the following day. In the time between 1904 and 1941 Japan certainly had shown no noticeable improvement in the niceties of conduct among nations that could warrant the belief that when she got ready to break with us she would formally declare her intentions and allow time for the message to be ceremoniously delivered to us with white gloves before any overt act took place. If our fleet commander in Hawaiian waters had been keeping his many ships reasonably well dispersed, instead of crowding all of them inside the small basin of Pearl Harbor, there never could have been the disaster of December 7, 1941, to be

written into the records as the greatest defeat the American navy ever suffered.

But greater than the sea disaster at Pearl Harbor was the land disaster at Bataan and Corregidor, soon to follow, and for the same reason—over-concentration. Bataan and Corregidor have been so little understood because of the four years of black-out that followed their surrender, that some little space is here required to tell what part over-concentration played in their doom.

Scarcely had we acquired possession of the Philippine Islands at the close of the war with Spain before army and navy officers acquainted with the Orient began to assume that Japan would some day try to wrest the islands from us. As early as 1913 there was an important threat. The occasion of it was an act passed by the state legislature of California which denied to Japanese and other Asiatics the right to own land. Woodrow Wilson was President and William Jennings Bryan his Secretary of State when this happened. Bryan rushed out to California and tried to persuade the legislature to withdraw the act. The Japanese had raised a threat of war over the discrimination against her people. In the Philippines there was more to the Japanese threat than the American people at home ever knew about. In the Islands at that time the mobile forces under the American flag and pay consisted mainly of battalions of Philippine Scouts. These were units of native troops commanded by American officers holding commissions especially authorized for this service.

In the Philippines when the Japanese were making their threat, at the isolated army garrisons the commanders of

the battalions of Philippine Scouts received orders from the headquarters of the Philippine Department to be prepared, in case war with the Japanese did come, to burn all military impedimenta and move their troops onto Corregidor Island in Manila Bay. The idea at Department Headquarters was that on Corregidor the forces would take refuge as in a castle until the United States navy could defeat the smaller Japanese navy and convoy an army from the Continental United States to the Islands. Certainly this was a plan, if plan it deserved to be called, that easily and quickly might have been put into operation.

Nevertheless, most of the American officers on duty with Philippine Scout troops were opposed to it in principle. These officers had spent many years with the native Filipino troops, had commanded them in dozens of skirmishes and other more serious encounters, and knew that when fighting with guerilla warfare tactics in his native jungles there is no better fighting man anywhere in the world than the Filipino soldier. These officers were confident that they could move their Scouts into the hills at any time, on a day's notice, and depending only upon wild game and native foods for their subsistence, hold out for months or even years against any invading Japanese force trying to conquer them. On the other hand, if required to move onto Corregidor the natural fighting ability of their Filipino soldiers, so versed in jungle warfare, would be lost. The worst side of this plan was that any troops voluntarily beleaguered on that tiny island would be depending entirely upon a quick defeat of the Japanese navy by the American navy. In case anything happened

that would prevent our navy from accomplishing this mission, the stores of foodstuffs on Corregidor could not last and the troops would be starved into submission. This was what many Scout officers in the Philippines were thinking and talking about as far back as 1913.

Then came 1921, the year in which the Washington Disarmament Conference was held. After much opposition from Japan, the conference allowed the United States a greater number of capital ships than Japan, in the ratio of 5 to 3. This ratio was believed by military and naval persons to be sufficiently favorable to assure the United States an early victory over the Japanese navy, should war come. A plan for the defense of the Philippines was accordingly based on the conviction that the American navy would not fail to defeat the Japanese navy, and would be able to transport loads of American troops from the United States and put them on the Islands. Under this plan not many American troops would need to be kept in the Philippines. Most of the troops stationed there could belong to units of the Philippine Scouts, and all future commissions to officers in command of these Scout troops would be given to citizens of the Philippine Islands.

By this new plan, in case war broke out with Japan and the Japanese invaded the Philippines, the troops already in the Philippines were to resist the Japanese armies in the field as long as they possibly could, and then withdraw onto Corregidor Island and into the tip of Bataan Peninsula, which lies across a narrow passageway of water from the island fortress and forms with it a single area of defense. Here the outnumbered army would defend

itself as from a stockade until our navy could defeat the Japanese navy and convoy to the Islands an army of reinforcements from the United States. In order to strengthen the natural defense of the area and to protect it from what might be a long siege, Malinta Tunnel was constructed on Corregidor, and at the tip of Bataan Peninsula storage places for ammunition and other military supplies were built.

But again there were many officers of long service in the Philippines who were as opposed to this new plan as they had been to a similar plan in 1913 and for the same reason; namely, that the plan staked everything on the expectation that the larger U. S. navy would have no trouble defeating the Japanese navy. These officers dared to believe that the Japanese navy, though smaller in size, might not be so easily handled in its own part of the ocean as was assumed by the planners. If this proved true, any troops bottled up on Corregidor and Bataan soon would find themselves in a sorry plight. Once they had voluntarily beleaguered themselves within this small area of defense there would be no escaping from it. A better plan, so thought these officers who had had much experience with the native Filipino soldiers, would be to move their troops into the hills, in case of a Japanese invasion that could not be checked, and from the mountain fastnesses and almost impenetrable forests fight the Japanese on terms in which the Filipino soldier, man for man, would have a decided advantage over the Japanese soldier.

However, there was another group of officers who had little experience in the Philippines. These officers, who

had cooked up the scheme for the defense of the Corregidor-Bataan area, and thought highly of their own cooking, were not disposed to listen to what the old Philippine Scout officers had to say on the subject. Instead, these staff officers went ahead with the plan of making Corregidor and the tip of Bataan a bastion of defense for use if resistance in the field against the Japanese became impossible. The plan completed, it was labelled the Orange Plan, and maneuvers were built around it.

More time passed, the Second World War came and the line-up of nations was about as had been expected for many years. The Japanese entry, as will always be remembered, was on December 7, 1941, and it was a blow that caught the U. S. Navy completely by surprise. For one full day and part of another the United States was almost too stunned by the incredibility of the act to believe it could be true. But by the third or fourth day the nation was ready to believe that the Japanese might try anything as their next move. On the Pacific Coast both civilian and military groups thought an invasion of California was to follow. There were hysterical reports that told of a Japanese invasion fleet moving first toward one port and then another. Some days it was only a hundred miles off the coast, and coming on at full steam. Without much doubt the Japanese could have landed troops at any point along California's coast during the month of December, 1941, if a large invasion force for the purpose had been in their plans. At least the Japanese might have seized the Hawaiian Islands, because the attack upon Pearl Harbor must have succeeded beyond their fondest hopes.

But the truth is that the Japanese had no intention of trying for an invasion of either the United States or Hawaii at that early stage of the war. They were still adhering to a plan over which they had spent years of work and study, one which called for the conquest of the Philippines, and from there moving on to an invasion and conquest of the whole of the South Pacific. The attack on the American navy at Pearl Harbor was meant to cripple it, so that it would be unable to operate against the Japanese navy and convoys, and to prevent it from escorting reinforcements from the United States to the Philippines.

The point here is that the Battle of Pearl Harbor was not for the Japanese an independent engagement at all, but was a maneuver in the Battle of the Philippines. Accordingly, soon after the American fleet was knocked out at Pearl Harbor the Japanese started their army moving forward by convoy from Formosa, landing it from transports along the beaches of Lingayen Gulf, north of Manila, at the very strip of beachhead on which American military experts had always said a Japanese army would some day try to land. The combined American forces in the Philippines and forces of the Philippine Government moved to meet the Japanese invading forces, and met them in some places on identical rice fields and areas of bamboo jungle where our troops had in the past fought flag wars against assumed Japanese forces moving inland from landings at Lingayen Gulf. All was going strictly according to blueprint on both sides, except that the Japanese by their sneak attack on Pearl Harbor had knocked out our navy, which by the Orange Plan was supposed to accomplish a quick

defeat of the Japanese navy and start convoying reinforcements to our side from the United States.

With half our fleet of capital ships having been knocked out in forty minutes at Pearl Harbor, the Japanese navy was now in a position to prevent the United States from sending any reinforcements to the Philippines for a year or more. This fact alone should have prompted our officers to take the Orange Plan from its file, tear it into a thousand pieces and curse the day on which such an asinine plan was ever devised—a plan which gambled our army on the chance that our navy would quickly defeat the Japanese navy. Yet while the Japanese were landing on the beaches of Lingayen Gulf with tanks, artillery and troops by the thousands and moving them quickly inland, the Orange Plan was taken out of its file and put into force. The American-Filipino troops on Luzon, fighting only with rifles and pistols against tanks and armored cars, were ordered into the Corregidor-Bataan stockade.

On the day the last weary unit of American-Filipino forces stumbled into Bataan and the gates behind them closed, there were inside the stockade rations to last at full ration strength no longer than two months, with no possible way to obtain a pound more until our navy, then crippled and lying in the mud at Pearl Harbor, could be rebuilt, the Japanese navy defeated in a battle at sea, and then troops and supplies convoyed to the Philippines. That would be two years away at the very least.

The story of what happened to the Corregidor-Bataan stockade is too recent to require a detailed account here. Briefly told, however, in the few months left the Ameri-

can-Filipino forces on Bataan defended themselves with sublime heroism against attack after attack by the Japanese, stacked division behind division. But every day starvation, sickness and battle casualties wore the valiant defenders down more and more. Came a day when only surrender could save from death the last starved, sick and wounded soldiers. From the tip of Bataan Peninsula where these surrendered troops had made their hopeless last stand, they were put through the long Death March of awful fame, ending with imprisonment in camps at which deaths from starvation and disease were to reach a total of over five hundred a day.

On the day that Bataan fell the Japanese started moving artillery forward to positions at the tip of Bataan Peninsula, from which shells could be lobbed across the narrow strait onto Corregidor. Day after day tons of shells rained upon that mound of rock. At last the situation grew as hopeless there as it had been on Bataan, and it narrowed to a choice between surrender and death by annihilation.

Meanwhile, in Mindanao and other islands of the Southern group there was a force of something like 15,000 that had been spared the Corregidor-Bataan self-imprisonment. This force was preparing to split up into organized detachments of guerillas and carry on guerilla warfare from the mountain jungles, the kind of warfare at which Filipinos have no equals, and the kind which years before the older heads in the Philippines had said should be the basis of resistance against a Japanese invasion. But the army of 15,000 on Mindanao and its adjacent islands was not permitted to turn to guerilla warfare. The Japanese refused

to allow the troops on Corregidor the rights of surrender unless the Mindanao forces and all other forces remaining loose in the Philippines were included with them. Hence these other forces had to surrender, or else become the cause of the massacre of their comrades being held as hostages on Corregidor.

The grievous sum of all this was that in five months the Japanese killed or captured practically all of the American-Filipino forces, who at the start had numbered nearly 100,000. The only troops to escape were a few thousand who, as members of small groups separated from the main bodies, ignored the orders to surrender and took up guerilla warfare on their own.

Some eight months after the surrender of the last of the Philippine forces it happened that all but a few of the senior American officers were moved from prison camps in the Philippines to camps in Formosa. This island was interestingly connected in recent history with that of the Philippines, because it had come into possession of the Japanese only shortly before the Philippines came into possession of the United States.

In the mountains of Formosa live a fierce race of aborigines with a language and physical features that identify them as akin to the natives of Borneo and Mindanao. Their number has been put at 100,000. Time and again the Japanese, after taking Formosa from China, had tried to drive these aborigines from their mountain fastnesses, in order that the rich camphor forests of the mountains might be harvested. But the resistance was too fierce. Finally the Japanese were forced to surround the mountain

area with a chain of forts, placed a few miles apart and connected with one another by a heavily electrified fence. Then, area by area, as a new patch of camphor trees was tapped, the chain of forts and the electrified fence were moved forward. But despite all the military expeditions and the money spent in trying to bring the Formosans of the mountains under their domination, the Japanese never succeeded.

In the meantime, in 1904–1905, Japan had defeated the armies of the Czars of Russia in one great battle after another. Later she had annexed in succession Korea and Manchuria and overrun the most populated parts of China proper. Finally she drove down the Malay Peninsula and captured 100,000 British, Australian and New Zealand troops, and in the Philippine Islands in five months she killed or took prisoner 100,000 American and Filipino troops. But on Formosa 100,000 dispersed natives, armed only with spears, for nearly half a century had resisted Japanese conquest, although Japan had lost many soldiers and spent plenty of money in an effort to conquer them.

What 100,000 Formosans of the mountains, armed only with spears, had done for nearly fifty years, 100,000 Americans and Filipinos, armed with rifles and machine guns, could surely have done for at least two years, if they had been allowed to turn to guerilla warfare. This is not mere supposition, for the few thousand soldiers of the groups that ignored the surrender orders lived through three years of guerilla warfare and came through it with far fewer deaths, in proportion to numbers, and in better

health than did the hundred thousand unfortunates who surrendered.

Corregidor-Bataan is the greatest defeat ever suffered by an American army, and the decision to concentrate troops into these two small areas, with only two month's supply of rations, and with the rescuing navy lying in the mud at Pearl Harbor, will probably be written into history as the greatest military mistake ever made anywhere, at any time, during 3,000 years of recorded warfare. Hitler's attack upon Stalingrad does not begin to compare with Corregidor-Bataan in enormity as a mistake. At Stalingrad, up to almost the end, the German troops had a chance of winning, and if they had, the war against Russia might have been won. But the withdrawal of troops onto Corregidor and to the tip of Bataan only put the troops into a stockade, in which they were doomed to defeat and surrender the day they entered it.

It is no valid argument, which apologists for the Bataan-Corregidor debacle sometimes try to make, that the mission of the Filipino-American troops was accomplished because their heroic resistance for five months delayed the Japanese from moving forward and thus gave the Australians and Dutch of the East Indies time to brace themselves for the invasion that was meant to follow the conquest of the Philippines. If the enemy's movement toward either Australia or the East Indies did depend upon the prior subjugation of the land forces in the Philippines, it never could have been started if the troops in the Philippines had been permitted to turn to guerilla warfare. In guerilla

warfare these troops could no more have been conquered than could the 100,000 Formosans of the mountains.

But just as only a few, so far, have seemed to realize that the act of concentrating instead of dispersing our forces in the Philippines was a colossal blunder which had to be paid for by the life of every soldier who was there, or by his suffering through four years of torture, starvation and disease in grim Japanese prison camps, so today only a few seem fully to realize that only dispersion can save all the millions of people living in our overcrowded cities from a mass slaughter that will exceed any horror the world has ever known.

Before any adequate start can be made toward achieving atomic security for our nation the great body of our people must become convinced that dispersion in itself is a defense against the atomic bomb. Dispersion and still more dispersion. And it is the only complete defense.

4

DISPERSION OF CITIES

THE CONTINUING growth of our cities under the pressure of intense industrialization has inevitably produced congestion and overcrowding. Factories and workers' homes were built close to each other because most workers walked from home to factory. And until recent years the sites chosen were generally well within the central area rather than on the outskirts of the city.

Today the automobile and the modern highway offer the means not only to relieve this congestion but also to promote the general welfare of the community. A factory now can just as well be located twelve or fifteen miles away from the central part of the city, and all of its hundreds of employees can make the trip in their automobiles over a wide expressway with less roundabouts and turns, less stops and starts at traffic lights and with less wear and tear to themselves and their cars than they now have in traveling three or four miles through crowded city streets.

A big manufacturing establishment which is producing arms or munitions or which can be converted to war

production, must be one of the first to be relocated under any plan for dispersion. As long as it is allowed to remain in the heart of the city, the city runs the risk of attack no matter whether the city is large or small. But if such a factory is moved to the perimeter of the expanded city and its facilities are scattered among a good number of widely-spaced small buildings, it will no longer be a danger to itself or to the city. The employees can hold their jobs by using their own cars or buses for the trip to the new location. Therefore the moving of the endangering factory away from the central part of the city will not necessitate the sudden moving of the homes of its workers.

If a city exceeds 15,000 population the removal of its endangering factories and other heavy establishments to its perimeter will not alone give it atomic security. Its inhabitants must also be more widely spread. A careful survey of the city's present density of population is the proper first step in approaching this problem. A point that must be kept in mind is that the atomic bomb, because of its great cost, will never be dropped on a target chosen by a pilot at random after his take-off, as might a TNT bomb costing only a few thousand dollars. On the contrary, every bomb used by the enemy will be the subject of a carefully planned operation, with a specific rewarding target for it located and a plane crew carefully briefed long before the plane which is to deliver the bomb takes off.

Effective atomic defense requires so thorough a dispersion of the population of a city that the number of

people a bomb can kill will not be great enough to make the mission a rewarding one. If the density of a city is low enough in all of its sections to make it impossible to find a rewarding target anywhere, the entire city will be safe from a bombing attack, no matter if the city has a population of only 15,000 or as much as 500,000.

The last-mentioned point is so important that it deserves a restatement. A city which sets out merely to reduce the casualty probability from a single bomb instead of making the whole city a place of such unrewarding density that the enemy will never plan to attack it, will not, when at the mercy of an enemy armed with an adequate stockpile of bombs, be any safer than it was before. On a city that has dispersed itself but is dispersed not quite enough, the enemy will be forced to drop more bombs. But requiring the enemy to spend more of his bombs to destroy the city is not *saving* the city. For this reason, the city which plans to disperse itself must plan on doing an adequate job of it. If it does not, the city might just as well save its money and effort and remain in its presently overcrowded condition, and in this condition brace itself for the destruction to which it is doomed.

Before any city can set up a trustworthy plan for spreading its population until none of its sections can be considered by the enemy as a rewarding target, that city must have a reliable set of figures on population density by which it can be guided. If there are no authoritative figures, some people will suggest one percentage of maximum density for the objective, and some another, with the probability that this critical matter will be settled by

the loudest voice or the foremost politician present, rather than by careful and authoritative calculations.

In the previous chapter 5000 was given as the minimum number of civilian deaths the enemy would have to inflict upon a city, where personnel alone is his target, to justify the expenditure of an atomic bomb. It is earnestly hoped that the reasons given justified the selection of this particular figure as the critical one. The figure, however, is offered only as a tentative one and should be revised whenever new factors or information from official sources require.

Only recently our government released information as to the number of deaths which would probably be caused by the explosion of a modern A-bomb, at various distances from its center of explosion. Because of the solemn nature of the subject there is every reason to believe that the government took care to make these figures as accurate as it is humanly possible to make them before turning them over to the trusting public. According to these figures, within a radius of one-half mile of the center of explosion of a modern A-bomb on a hypothetical, average city, the deaths would number 90 per cent of the people within the area; from one-half to one mile away, they would be 50 per cent; from one to one and one-half miles away, they would be 15 per cent; and from one and one-half to two miles away, they would be only about 3 per cent. Beyond two miles of the center of explosion practically no lives at all would be lost.

Computing with these figures for a hypothetical city having a uniform density of 1000 inhabitants to the square

mile, it is found that the inner zone, whose radius is one-half mile and whose area, consequently, is .785 square mile, there would be 707 persons killed. In the next ring, whose radius is one-half to one mile, and whose area, consequently, is 2.36 square miles, the number killed would be 1180. For the third ring, whose radius is one mile to one and one-half miles, and whose area, consequently, is 3.93 square miles, the number killed would be 589. For the fourth ring, whose radius is one and one-half to two miles, and whose area, consequently, is 5.50 square miles, the number killed would be 165. Adding the death probabilities for these four zones, 707 plus 1180 plus 589 plus 165, we have a total of 2641 persons who would be killed from a single bomb dropped on a hypothetical city with a uniform density of 1000 to the square mile.

From the above figures, assuming the enemy's modern bomb is of the same power as our own, it is obvious that should the enemy require 5000 casualties as his minimum reward, when his only purpose in bombing a particular place is to kill all the people he can, any city with a population density not exceeding 1000 to the square mile in any uniform section of it at least the size of the pattern of a single bomb blast (about 12.5 square miles), could not be considered a rewarding target for this costly bomb. Mathematically, before any such area could suffer 5000 casualties it would have to have a population density of 1893 to the square mile.

Assuming for a moment, then, that 5000 deaths is the enemy's minimum figure for his atomic bomb, when his

target is solely the destruction of human lives, a city with a population density less than 1893 to the square mile in any section of it large enough to be selected for the definite target could count itself safe from being attacked by means of an atomic bomb, while a city with large areas of greater density could not count itself safe. If the density is below this figure, the enemy would never plan an attack upon the city, knowing that in case he should, the bomb, mathematically, could not be counted upon to yield the 5000 deaths he must claim as his minimum reward. But if the city has a large section with a density above this figure, he can give the city a beaded pin on his war map, marking it for a planned attack when targets of higher priority have been dealt with, or as a target of opportunity for a plane driven away from its primary target. This, again, it must be kept in mind, is taking cases of cities that have no value for bombing other than the potential military manpower and the potential war industry manpower they represent.

Having arrived at this critical density figure in the manner explained, it will be easy to revise it, if in light of better information the rewarding death figure is found to be greater or less than the 5000 figure suggested above. If the cost to the enemy for producing atomic bombs, even after all facilities are built and manufacturing efficiency has reached its peak, is still so high that he cannot afford to use a bomb of the presently presumed size solely against personnel unless there is a promise of 10,000 deaths, then the critical population density figure would be twice that named above or 3786 inhabitants to the square mile.

On the other hand, if the cost of manufacturing and delivering bombs upon targets is cut to a figure that will justify the enemy using a bomb although the predicted number of deaths from it is less than 5000, then the critical population density figure will be less than the 1893 figure given above.

The chances seem to favor the reduction of the cost of manufacturing bombs rather than the increase, or rather that more destructive power can be put into bombs at less cost than at present. Our government has released information to the effect that a bomb having twice the power of the present A-bomb could not do as much damage to a city as would two bombs of the present size dropped at some distance apart on the same city. Nor would a hydrogen bomb having a thousand times the power of a modern A-bomb have a thousand times the destructive effect. In each case this would be true because the more powerful bomb would waste an enormous amount of its power near the center of explosion. This being true, the converse of it must also be true, which is that the greater danger does not lie in the ability to manufacture hydrogen bombs and A-bombs that are terribly more powerful than the present model, but in overcoming certain technical difficulties with what is known as critical mass that will make it possible to manufacture bombs smaller than the present bomb at a cost proportionately less.

If that does become possible, and there is hardly a doubt that it will, if indeed it is not already, then the critical population density for a city could be less than the figure

given above. Not by any great amount, however, because the stockpile of bombs will be limited to the number of bombs already manufactured when war starts, and when the point is reached where a bomb cannot destroy more than 5000 civilians the same bomb probably had better be saved for use against a mobile target, such as a troopship at sea or a division of soldiers on the battlefield. Nevertheless, in order to be working with a margin on the side of safety rather than on the side of risk, it is here recommended and urged that a city setting out to accomplish atomic defense by means of dispersion should set its maximum allowable density at 1000 inhabitants to the square mile, with no section of the city allowed to exceed this density.

One distressing fact is that there are not now many cities in the United States of over 15,000 population with a density average as low as 1000 to the square mile, at least not in every area the size of a target for an atomic bomb. Fifty years ago dozens of cities could claim this low density. What has happened during the past fifty years is that our cities, with a mania for growth, have achieved enormous size, which has been their wish, but they have done far too little about increasing the extent of their boundaries. Indeed, in most of our large cities people are now living five times more closely crowded together than they once were. But if this condition is a distressing fact, it is still not hopeless. If we once had adequate dispersion among most of our large cities, certainly with determination and the right kind of planning we can have it again.

Therefore, the very first step each city must take toward

accomplishing defense against atomic bombing will be to take into its incorporated limits sufficient areas of surrounding land to give its life and commerce a chance to spread widely apart. After this adequate enlargement of its area has been made and proper dispersion accomplished the city must, of course, exercise a strict control over all future building and developing, so that atomic defense having once been achieved it can also be preserved. This the city can do only through appropriate zoning laws and a permanently established zoning and planning authority.

After the boundaries of a city have become greatly extended, an area of generous space, which will be referred to hereafter as the FACTORY ZONE, must be zoned for the location of factories, machine shops, packing plants, railroad terminals and yards, air fields and for all other heavy establishments. Throughout the area the buildings and facilities must not only be well dispersed but also dwelling units of any kind must be excluded. If the city is a port, its waterfront must be similarly zoned for the facilities of waterborne commerce.

It is convenient to think and speak of the factory zone as an area at the perimeter of the city, completely encircling it. That, however, could only be possible with a city that does not face upon a harbor or river, or does not have the bank of a mountain at its rear. With the usual city, consequently, the factory zone will be an area upon one or more of its flanks. It is also convenient to think of a city as having an area that approaches a square in shape. Actually, though, the city to be expanded will probably grow elongated in shape, because the terrain features that

determine the building sites for cities with large areas are likely to be themselves elongated in shape. Furthermore, an elongated shape has the virtue of increasing the atomic defense of a city, while convenience of access will not be lost by increased length, because the arterial streets and expressways will afford excellent connections between all the sections.

At the start of any city's program for dispersion only those few establishments that are rewarding targets for bombing must be moved to the factory zone. These include the large factories turning out war materials and supplies, or those that can readily be converted to this purpose, the railroad terminals and yards and some others. All other establishments, such as bottling plants, dairy product plants, flour mills, clothing factories, furniture factories and many others can be allowed to remain where they now are until times are more favorable for relocating them in the factory zone. They are not the kind of establishment that will draw fire, and in their present locations do not unduly contribute to population density. It must be assumed, however, that as new buildings and facilities for expansion are required, these plants will also be shifted to the city's factory zone.

At the business core of the city the modern skyscraper, which stacks humanity floor upon floor into the clouds, increases enormously the square-mile density of the area on which it stands. No more of these steel-skeletoned towers should ever be built, and fortunate is the city which now has few or none of them to worry about.

There are practical reasons why lawyers, doctors, den-

tists and other consultants still will choose to have their offices located above the street floor, and clothing stores, drug stores, jewelry stores and other retail establishments must be located on the ground floor. These two general requirements supplement each other to commend the two-story building as standard architecture for the future throughout all business sections of a city, as was true fifty years ago. The construction of a building of more than two floors should be permitted only on condition that there be permanently maintained parking and other open spaces to compensate for the undue height of the building.

After a city has succeeded through its zoning and planning authority, in moving to the factory zone all the heavy establishments that might draw fire upon the city if allowed to remain where they now are, and has begun spreading its business sections apart by controlling the height to which new buildings can rise and encouraging a good number of shops and stores to move to drive-in locations, the city will still have before it the problem of dispersing houses in its residential sections.

Whatever else may be done about this problem, in nearly every city there must be found a way to correct an evil of the automobile age that has been causing houses to become more and more crowded together. Before the time of the automobile the street in front of a house cost the owner of the house almost nothing for maintenance. It was a street of dirt, and got a few squirtings of water from a horse-drawn waterwagon during the dry months of summer, as a pretense at laying the dust, but that is about all the attention it ever did get or require. Because

there was almost no cost for street maintenance, the street frontage of most of the homes in the city at that time was ample. In fact, a city lot at that time normally was large enough for a house, a lawn at the front of it, a garden and orchard in the backyard and at the alley a barn for a span of buggy horses and sheds for a milk cow and a small flock of chickens. But strangely it is the automobile that is now depriving home owners of houses built on such ample grounds. The automobile requires a paved street, the cost for which must be borne in whole or great part by the property facing upon it, and the amount is so great as to cause home frontages to shrink more and more until now the usual lot has a width of only 50 feet, or even less, allowing only enough room for the house and a narrow driveway alongside, through which the automobile must get to and from the garage at the rear while rubbing the paint off its fenders.

This crowded condition can be overcome in part by doing away, as far as possible, with the idea that the residential sections of the city must be laid out with miles of wide streets and wide cross-streets cutting the area up into rectangular blocks. This was the custom when people walked or rode in carriages to get from one part of the city to another, but has been a very expensive custom and one not at all required since the automobile became the normal method of travel. One of the plans for dispersal provides for replacing the rectangular block and substituting large areas to be laid out for new homes. Through these residential areas would run six-lane arterial streets. These arterial streets would be at considerable in-

tervals and in general would radiate from the business core of the city to the factory zone or in the direction of neighboring cities. No homes of any kind would be allowed frontage on these wide arterial streets, but on either side of them would run strips of good width zoned for drive-in establishments.

At right angles to these arterial streets and at considerable distances apart would be dead-end streets leading into park-like areas. Leading from a dead-end street would be short lanes and loops which would all be fronted with houses. But because these driveways would serve only the homesites in the immediate area and not as thoroughfares, a street with a two-lane paved surface and with wide unpaved shoulders, like a county road, would be adequate for the dead-end street. The lanes and loops leading from the dead-end street would require only one lane of paved surface. The owners living in these park-like areas certainly should not mind driving their cars two or three hundred yards over one-lane and two-lane driveways getting out into the arterial street, if they have before them six lanes of paved surface over which they can travel the remaining fifteen or twenty miles of their trip with few stop lights and no speed zones less than forty miles an hour. The driveways within the park area built in this economical manner might well be fronted with lots 150 or 200 feet wide, yet costing the property owners no more for street construction and maintenance than they now are paying on their squeezed strips of 50-foot frontage in blocks fronted and sided with wide streets used for all kinds of traffic.

At first thought it may seem that a residential area laid out in the manner described above would be a labyrinth of dead-end streets, lanes and loops, and no one not already thoroughly familiar with the area could ever locate a house anywhere within it. This would be the case if the city persisted in using for the new area the same bewildering system of designating streets and homes now used in the area of rectangular blocks, which gives a name to each street, no matter how short or unimportant it may be as a street. But if the city will designate a series of dead-end streets by consecutive numbers with reference to the arterial street, and designate also by consecutive numbers the lanes and loops branching from a dead-end street, and finally the houses of a row by consecutive numbers with reference to the street, lane or loop on which it is fronted, a total stranger to the city would be able to locate a home anywhere in the city as easily as one can locate an office anywhere in the heart of Manhattan when one knows only the name of its street and building entrance number and the number of the room.

Still more dispersion among the houses in the park-like areas would be accomplished by giving greater depth to a lot than there is now, so that no lot would consist of less than 2 acres. On these 2 acres of land besides the house and customary lawn at the front there would be space enough at the rear for a garage with graveled turn-round in front of it, a garden and grove, and for just about anything else the owner should care to build or plant.

The residential sections of a city which are chopped

up into conventional rectangular blocks with thoroughfares crossing and crisscrossing them ruthlessly, could not, of course, be changed at once into park-like areas. Nevertheless, much can be done in that direction, if some of the streets are widened into arterial streets and the others either closed or made dead-end streets. It is conceivable that any city with areas of homes along worn-out streets, and with not enough money in its treasury to reconstruct these streets in full, can with a little intelligent planning save at least a half of the presently estimated cost for repairs by closing one end of certain streets, changing some streets into one-lane passageways, and doing away with others entirely, and after these changes have been made leaving the area more beautiful and desirable than it was before.

No doubt many will say right away that this idea of giving 2 acres of ground to homes sounds well and good for homes to be built in the future but does not explain how houses already built, and admittedly standing crowded too closely together for atomic defense, can be made to thin out. They will admit it is all right for a city through its zoning laws to require factories which would draw fire to be displaced to the factory periphery at once, to prohibit the construction of any more tall buildings, and even to refuse a building permit for a new residence in any part of the city unless it has around it a minimum of 2 acres of ground, but they still will declare that no city government has a right to say to a man who has already built or bought a house that he must tear it down or move it to a less congested place. And they will be dead right.

Between requiring a factory to displace and requiring a home owner to displace there is a different principle involved. Once a man has bought or built a home it becomes his castle, and his right to live in it should never be taken away from him by compulsory surrender unless the public interest clearly demands it, and then only after adequate compensation has been made him. If this principle of the inviolability of the home must be overridden by dictatorially and arbitrarily telling the owners of millions of homes that they must move, it will mean that we shall destroy democracy in America by trying to accomplish atomic security. In that case, to choose between the two forms of destruction, it would be just as well to sit tight and wait for the atomic bomb to come and do its worst.

The problem, then, is how to thin out the homes already built, but without requiring a single home owner against his will to move from a house he has already bought or built. The problem is tough, as are all problems of atomic defense, but by no means is it insoluble.

If the city is a typical city of 100,000 or more population, a survey of it will disclose that in the older residential areas there are not a few homes of permanent construction that were built before the automobile had started to shrink property frontage, and about these homes there are many yards of good space. In this section also will be found many old frame houses which, if they could speak for themselves, would like to come down. A third type of building found in considerable numbers in the same area is a frame house of four or five rooms with rather

plain exteriors and not much of a credit to the section of the city where it stands. This type of building has sprung up within the past few years at the side of a permanent home on a small corner of ground which has either been sold by the owner of the permanent home, or the house has been built by him and rented out. In the new additions to the city two types of houses stand out. One is the large house of permanent construction, with ample yard space surrounding it. The other is a frame house of five or six rooms, very modern and very attractive, but unfortunately standing on a lot with only 50 feet or less of frontage, on a street crowded with houses of the same type. Taken all together, the old and the new areas and all the types of buildings covering them, the density is too great for atomic security, and a thinning-out must be accomplished.

However, when it comes to the work of dispersing homes what must be taken into account is not how crowded the houses may be that presently are standing on a particular street or in a particular section, but how many dwelling units there are on an area of 12.5 square miles, the approximate area a single modern A-bomb can cover with its destruction. If the city is typical, the number of houses of brick or stone, and consequently unmoveable, and those built of wood that are too large to be easily moved, are together so greatly outnumbered by the readily moveable small houses and the buildings that should be wrecked, that the removal of these would leave the permanent homes and the large frame mansions and most of the recently built smaller houses with an average

of not less than 2 acres to the dwelling unit, which here is deemed the minimum average space homes must have before a city can regard itself safe from an atomic attack. If the city is not typical but rather has an unusual proportion of fine homes, the chances are that these homes already have about them spacious yards and consequently not many moveable homes need be taken from the general area to give the homes that are to remain the required minimum average of 2 acres of space.

The dispersion of homes until the dwelling units in each residential section have an average of not less than 2 acres of yard space can be accomplished in each city by taking over an area in which there are no buildings, or very few. This we may call the RELOCATION AREA, in which 2-acre lots would be sold to actual homeseekers, one lot only to any one person, under a plan of government aid to be presently explained. For the typical city the size of this relocation area would be approximately three times the total area of its present residential sections. It will be convenient to speak of it here as one piece of land, and for some of the cities it undoubtedly would be, but for others it would consist of two or more separate tracts.

During the first two or three years of the operation of relocation most of the houses on the relocation area would be those which have been moved there from the other areas, because building materials and labor are likely to be too scarce during these early years to allow much new construction. Furthermore, the moving of houses into the area rather than the building of new ones would be encouraged in every way and may even be required in some

of the cities, as only in this way could the thinning of houses in the overcrowded old residential sections be expedited.

In some of the cities the moving could be done by the city. In other cities it would be handled by private contractors. But in either case the job would not be difficult. With the use of modern house-moving equipment a frame house of large size can be lifted from its foundation, put on pneumatic tires, and pulled along a street about as fast as the tractor hooked onto it can normally move. At Hibbing, Minnesota, where not so long ago an entire city had to move to a new location to make way for a new open-pit iron mine, there was a good demonstration of how really easily and at what small cost frame houses can be moved when there are enough to be moved at one time to make a project out of the work.

A vacated lot might be readily sold to the owner of any adjoining piece of property on which stands one of the permanent houses or large frame houses that will remain in the old area. If this cannot be done, it might be bought by the city or by a real estate company, to be held until it and neighboring vacated lots make up a minimum of 2 acres, and then the whole would be offered in one piece as a desirable homesite. However disposed of, the amount received for it should, in the usual case, be sufficient to reimburse the owner for the small sum he would be required to pay for the subsidized lot on the relocation area, and enough besides to pay for most, if not all, of the costs for hauling the house to its new location and constructing a new foundation for it. On top of

that, the house, when it has been set up on the attractive and spacious lot in the relocation area, should be more valuable than it was before.

It is true that many of the houses in the old area will be tied by mortgages to the property on which they stand. But because removal of homes to the relocation area will be to the interests of the mortgage holders as well as the homeowners, there seems no good reason to doubt that transfer of the mortgage title from the old piece of property to the new will be allowed in every case where transfer is requested.

Those who are quick with figures may say that if an area of 2 acres is allowed as the minimum area for a family dwelling unit on the relocation area, and also as the minimum average area to the family unit to which the old residential sections must be thinned, and that if four people to the family are approximately the national average for the dwelling unit, approximately 1280 persons to the square mile would be living in the residential areas after the work of dispersion is accomplished. This would be exceeding 1000 persons to the square mile, the number which a city should set as its density objective, if the areas were solid with residential lots. But deducting from the average square mile of area in the residential sections all the space that would be taken up in arterial streets, drive-in establishments along the arterial streets, grounds for schools, churches and parks, it is safe to say that in any area of 12.5 square miles in which homes have no less than 2 acres of ground, the population density would not exceed an average of 1000 to the square mile.

The relocation area would be the principal means by which the city would achieve low density of population, but in addition to it the city should give thought to providing more space for parks, particularly the natural parks which cost little for upkeep, to extending the grounds of schools and hospitals, encouraging the congregations of its several churches to surround their churches with ground for the planting of groves and the building of ample parking space, and to dozens of other projects within the city which would mean less crushing and crowding for all.

Also, once a city has become dispersion-minded there should be a decided increase in the development of new residential areas by private capital, in which the property, as in the past, would be handled entirely by arrangements between developers and buyers. This should be especially true of the areas suitable for those who can afford to pay for the construction of sumptuous homes. The only important new control the city would exercise over such residential areas would be to zone them for a minimum yard area of 2 acres to the dwelling unit.

Some of the cities when they start expanding enormously are going to run into problems peculiar to expansion, such as spreading beyond a county line, overrruning suburban cities, bumping into other large cities, and so on. None of these problems, however, is unsolvable.

If a large city must overspread its present county in order to expand adequately, the state should allow a consolidation of counties, so that the expanded city will not be forced to become divided between two or more coun-

ties. Or for a particular city faced with this problem the situation might best be handled by taking the city out of county government entirely and giving it the status of an independent city, such as already has been done for Baltimore, St. Louis and for all the large cities in Virginia. In case an expanding city spreads beyond a self-governing suburban city, the absorption of the small city into the large one must be allowed; otherwise there would be a complicated situation of one city lying completely inside another.

In a case where two or more important cities are occupying the same industrial area and cannot expand their boundaries adequately without bumping into one another, it might be advantageous for the two or more cities to consolidate into a single city. The arguments that have been given here for the dispersion of cities in order to achieve atomic defense do not intimate that the cities must stop growing in size of population, but only that their population densities must be decreased. In fact, it can be expected that in some instances the consolidation of two or more cities into one would help the cause of dispersion.

Houston, Texas, with its area of neighboring cities can be taken as a good example. Houston, by taking into its incorporated limits all of the other cities and towns on its side of Galveston Bay, can have the longest waterfront of any American city and unlimited space extending inland for factory zones and residential sections. Within this magnificent area a determined new Houston—and to those who know the city well, Houston is already the very essence of determination—could grow into a city of

two million, three million, or even larger, and still not have a population density in any sizeable area exceeding 1000 to the square mile. Consequently it would be in no more danger from atomic bombing than a city of only 20,000. Corpus Christi is another port city with a bright future, having large sections of vacant land and miles of water frontage available for its area of expansion.

It was said above that almost all of our cities of over 15,000 population presently have areas that are too crowded. But the buying of additional land and costs for developing it are burdens which not many of these cities could shoulder alone. Much financial assistance must be given them from their state governments and from the federal government.

The state will have the obligation, as it now has, of aiding the cities in the construction of their many arterial streets that are to serve also as inter-city highways. The construction of these arterial streets will be a major item of cost confronting the cities concerned with expansion, and if the state government finds that it can bear the larger share of the cost, at the expense, perhaps, of other highway construction in the state for the time being, it will have made an important contribution toward helping its cities achieve atomic defense.

Among many other obligations the federal government owes the cities in helping them with atomic defense, is to be generous in the granting of loans through the Reconstruction Finance Corporation to the war industry plants and other establishments which may be required to relocate at once in the perimeters of the cities, and

firm in its refusal of loans at this time to other companies seeking funds for plant expansion which violate the principle of decentralization of war industries and facilities. But in direct financial assistance to the cities in accomplishing dispersion of their residential sections and endangering factories the federal government owes the greatest obligation of all. Unless the federal government lends generous assistance with this work, not many of the cities will be able to achieve the atomic security they seek.

This is assistance that the cities concerned have a right to ask for from the federal government without feeling that they are begging for it or asking favors. The citizens of these cities have a good part of their incomes taken from them by the federal government in the form of income taxes, excise taxes, internal revenue taxes, and other federal taxes until, as all know, there is little left which could stand further taxation, certainly not enough left for the cities to assume that they could raise by means of increased local taxes the money with which to pay in full for all the works that will be required to achieve atomic security. Really, about the only way a city could attempt to raise the required amount itself would be through the sale of some more municipal bonds. But who would want to buy for this or any other purpose a bond offered by a city that is now faced with atomic destruction? On the market the bond could not be considered a sound investment until *after* the city has its atomic defense in order.

As the federal government does take away from the citizens in the form of various taxes such a large part of

their incomes, it cannot in good conscience say to the cities that are now faced with atomic destruction that it needs all the money collected in taxes to help the Atlantic Pact nations build up their armed forces and keep them supplied with Marshall Plan aid, and pay the enormous bill for expanding our own armed forces, in addition to paying the normal expenses of government. The government cannot say that because of these obligations it has not a cent left to spare to the cities for their atomic defense programs—that they will just have to get along for themselves the best way they can. Of course our federal government has no reputation for pushing the cities off with a hard-luck story of its own in any such manner.

On the contrary, as the record stands at the moment of this writing Congress has already appropriated 3.1 billion dollars for the building of air raid shelters in the cities. This is a lot of money, even for the United States, which has ceased to be staggered by big fiscal figures, and if graft and misuse can be kept away from the spending of it, it could pay for the digging of enough holes in the ground to give one to every man, woman and child to tumble into, like a prairie dog, whenever an air raid siren starts sounding. Unfortunately, however, air raid shelters are no defense against the atomic bomb. The people who must crawl into the ground to keep from being killed by an atomic bomb are not going to be much better off than they were before if they come up out of their holes after the explosion to find everywhere about them a city crackling with flames and smothered with smoke and the whole area sown with deadly radioactivity. Nor

will it be of much comfort to them to know that in their city there are corps of volunteer fire fighters and stretcher bearers, when the number of seriously injured among the volunteers themselves will be exceedingly great. What the people of a city will want is atomic defense, not merely atomic rescue, and this they can have only by spreading their city out until it is no longer a rewarding target for the enemy's atomic bomb.

When the construction of air raid shelters and the organization of brigades of fire fighters and stretcher bearers are recognized as measures that are falsely leading the people in the cities into believing that security against atomic destruction is being provided for them, the citizens of all cities of population exceeding 15,000 will have the right to demand that the federal government aid them in obtaining real atomic defense for their cities. This the federal government can do by appropriating funds sufficient to cover the cost of the additional land the cities must acquire for their relocation areas and by helping in considerable measure to build the water and sewage systems and construct the streets in these new additions.

An estimate, with many factors involved, puts at approximately 8 million the total number of houses in the cities exceeding 15,000 population that must be moved to the relocation areas. This will require 20 million acres of land for the relocation areas, allowing 2 acres as the minimum ground space for each dwelling unit, and allowing space for the arterial streets, drive-in borders along the arterial streets, space for schools, and other non-residential spaces within the relocation areas. Because the boun-

daries of the cities must be extended at considerable distance beyond present boundaries into what now are farm lands or waste lands, the average cost for the relocation areas should not exceed $250 an acre. This figure will at least serve for the purpose of estimating an appropriation. 20 million acres at $250 an acre gives 5 billion dollars as the amount of money Congress should appropriate for purchasing relocation areas. In addition to this amount 10 billion dollars should be appropriated for buying land for factory zones and putting in the water and sewage systems and building the streets in both new areas. A total of 15 billion, divided over two fiscal years, is here estimated as sufficient federal aid toward accomplishing atomic defense for all the cities in the United States exceeding 15,000 population, with the exception of New York City, Boston and the crowded neighboring cities, the cities of three counties in Connecticut, of five counties in Northern New Jersey, all of the cities of the state of Rhode Island, and Washington D. C. These cities are special cases, and will be given further comment.

The 15 billion dollars are estimated sufficient assistance to come from the federal government provided, of course, the sum is properly handled. What is meant by proper handling is that the federal government, through a commission especially created for the purpose, would keep the expenditure under supervision and control. This commission would turn over to a city entitled to receive the aid a portion of its pro rata share from time to time, as required, but no part of it until such city has submitted to the federal agency a satisfactory plan providing for the

acquisition of a relocation area of size estimated to reduce the density average of homes in its present residential sections to not less than 2 acres to the family dwelling unit, prohibiting the building in the future of a new house anywhere within the city that will not have 2 acres of land on which to stand and providing for the purchase of sufficient land to give the city an adequate factory zone with a wide belt of land to be left vacant between this zone and the rest of the city.

The cities exceeding 15,000 population vary so widely among themselves in the sizes of their areas, the value of adjoining property, and in regard to so many other factors that the only practicable way in which to divide the 15 billion among them would be in proportion to their respective populations, as shown in the 1950 official census. To give a few examples of the pro rata shares: a city of 15,000 would receive approximately 3.3 million dollars; one of 100,000, about 22 million; and one of 500,000, approximately 110 million. (In the Appendix is a complete list of cities of more than 15,000 population, and their pro rata shares.)

The sum for any city, though large, would not for the average city be enough to buy the required amount of land for the relocation area and the factory zone, and to pay for developing these new areas with water and sewage systems and paved streets. But it must be remembered that lots in the relocation area, though subsidized, would be sold to bona fide homeowners for enough at least to cover the cost of the land (about $500 for the 2 acres), and that factory sites in the factory zone, lots for drive-in

business locations along the strips bordering the arterial streets, and grounds for churches and other semi-public institutions would be sold at fair market values. The total amount received from all these sales of property, combined with the amount received from the federal government, plus the aid the city would receive from the state for the construction of arterial streets, should, for the average city, be enough to bring about proper dispersal of homes without requiring any sacrifice from the owners of houses moved from the old sections to the relocation area, and without putting the city into debt for a new bond issue. It is true that some of the cities would not be able to buy acreage for their relocation areas at an average price as low as $250 an acre, because of high land values in their regions, but for these places it would also be true that the land to be sold for drive-in locations along the arterial strips and factory sites in the factory zone can be priced correspondingly higher, so that the one condition should balance the other.

In fact, a city that buys its land carefully, takes measures to prevent jumps in land prices, makes good sales of the drive-in locations and factory sites, and is generously aided by its state on the cost of construction of arterial streets, should be able to put aside enough money to complete the construction of the two-lane and one-lane streets in the relocation area and take care of transporting the moveable houses that are to go from the old sections to the new. Naturally, a project of this kind would be a challenge for each city to give every effort toward thriftily spending its share of federal appropriations for atomic

defense. But if a city does not undertake the project with such determination, and will allow speculators in property and others to horn in on the work with the idea of lining their own pockets, then, of course, the amount of money received from the federal government would not be sufficient by half to attain atomic defense for the city.

After a city has qualified itself to start receiving portions of its pro rata share of the federal appropriations to buy and develop its relocation area and factory zone, how and at what price the city should sell residential lots on the relocation area to actual homeseekers, the prices it would ask for drive-in locations along the arterial streets and for factory sites in the factory zone, the amount of assistance it would lend to the work of moving the moveable homes, the manner of its disposing of the vacated pieces of property in the old section—all are details to be left to the decisions of the city concerned. The federal government will have fulfilled its obligation to the cities when it appropriates the necessary 15 billion dollars and creates a commission through which it can be assured that every city to receive a share of the fund will produce and follow a plan of dispersion that will reduce its residential density to a minimum of 2 acres to the dwelling unit, and will without delay cause all of its endangering establishments to be displaced to its factory zone.

The subsidized relocation area and factory zone by which a city will obtain its atomic defense will not put the city into the real estate business permanently, nor is any experiment in socialism going to be tried out. In some regions of the early West it was not unusual for a

city to own the entire townsite at the start, and to sell residential and business lots to whomever it could. The minute a lot was sold it became private property, and when the last lot had been disposed of the city was out of the real estate business for good and all. It would be the same with the relocation area and the factory zone. After all the lots and sites are sold the city's control over the population density in all of its areas would be exercised solely through appropriate zoning laws and its permanently constituted zoning and planning authority.

Appropriations of 15 billion dollars from the federal treasury, spread over two years, to be spent upon relocation areas and factory zones for the large and middle-sized cities should not only give them atomic defense, but also do other things for them of great and enduring good. Because many old houses will be wrecked and others moved to the relocation areas and set upon new foundations, the cities will be doing the best jobs of slum clearance they have ever done. Furthermore, the expanded cities will have a better chance to combat crime and corruption by destroying the roots of their evil.

Many years ago Viscount James Bryce in his *The American Commonwealth* told us that our large cities were our one conspicuous failure in democracy. His observation was not unfair. In the large cities have flourished gangsterism, rackets, graft and many other evils from which other parts of the country, by and large, have been free. But the viscount with further inquiry might have observed that in our large cities a strictly residential section, a manufacturing zone or a strictly business part is

seldom disgraced with crime and vice. Most of the crime and vice in our large cities is in the squeezed areas where residential sections and business sections overlap. Here is found a distressing scene of small shops and stores with families living on the upper floors, rows of tenant houses crowded wall to wall, filthy streets, garbage and ash cans at the curb, washing hanging from windows, old people sitting on doorsteps during the summer evenings trying to get a breath of fresh air and children playing in the street. In these drab, cheerless, polluted quarters humanity does not have a proper chance. By spreading a city out, and segregating stores and offices, manufacturing plants and dwellings into their proper zones, it will be made possible for the lives of all in a big city to be more wholesomely lived.

It has been admitted that atomic defense through dispersion cannot be gained in New York City, Boston and its cartwheel of neighboring cities, the city of Washington, three counties in Connecticut, five counties in New Jersey, and the entire state of Rhode Island. New York City does not have room in which to expand adequately as a single municipality because it is squeezed between the state of Connecticut on the one hand and New Jersey on the other. Its population of nearly eight millions is sardined into an area no larger than the area of New Orleans, whose population is only about one-fourteenth as large. Lacking the space to spread laterally, the city has taken to the clouds with its skyscrapers.

Boston cannot expand because it is fenced about with

large cities as badly in need of room for expansion as herself. Before the metropolitan area of Providence could be properly spread out it would require at least a third of the area of Rhode Island. Connecticut has three-fourths of its population crowded inside three counties. New Jersey has two-thirds of its population inside a pocket that is within commuting distance of New York City. Washington is a special problem, which will be discussed at length later.

A Chinese proverb says that one picture is worth a thousand words. On a map of the United States, starting at Boston, draw a line to Providence, from Providence to Hartford, Hartford to New York City, New York City to Newark, and using this slightly zig-zagged line as an axis, draw an oval about it. Let this egg-shaped oval be called the Area of Utter Destruction.

This Area of Utter Destruction, which is no larger in land area than some of the counties in the West, has crowded within it over 15 million inhabitants—more than a tenth of the whole population of the United States. The enemy could let fall an atomic bomb almost anywhere within this teeming area and have a rewarding target, and by covering all of its densest parts with saturation bombing could kill at least 10 million.

If ten years instead of four were the estimated time the cities have left to achieve atomic defense through dispersion, there would be presented lengthy arguments why Massachusetts, Connecticut, Rhode Island, New York, and New Jersey should make common cause of their vul-

nerability to atomic destruction and unite into one large state. This new state would have an area of about 72,000 square miles. It still would be only sixteenth in size among the other states, but second to none in agricultural and manufacturing wealth, historical spots and variety of recreational places. But the real point is that within this one area, with many miles of present state boundaries eliminated, all of the large cities, uniting with neighboring cities, would have a chance to spread until safe from atomic destruction.

Because it is unlikely that the five states of the Area of Utter Destruction can be induced, in the short time available, to unite into a single state, it appears that the only other way in which its 15 million people can be saved from terrible disaster will be by the relocation of most of its factories in other regions. What is to stop these factories from moving? Surely the time has come in this stark crisis of the nation when civic organizations could not hold it a sin for a factory management to consider moving to a safe location. On the contrary, if a city is so situated that it cannot expand its area so as to give its factories a safe zone at its perimeter, the leaders of its civic organizations should be among the first to let the factories know the truth, and wish them good luck in other places. When the endangering factories have been moved elsewhere and the city has shrunk in size of population to possibly a fourth or fifth of its former size, it may be that it will have a chance to escape from an atomic bombing attack. If a city of, say, 250,000 does not have

open land surrounding it over which to expand itself, better for it and for the country that it dwindle to 50,000 and live than to hold onto its crowded factories and swarming humanity and be blasted from the face of the earth. And if each stockholder in a factory, knowing that the factory is doomed to destruction if allowed to remain where it now is, insists upon its relocation, he will be acting to save the lives of employees and their families, his duty to God to do if he can, and he also will be acting to save his investments, which he certainly has a right to do. Moreover, he will be helping to save America.

The factories moved from the Area of Utter Destruction will be followed by millions of employees, and a proportionate number of merchants, professional men and many others must of necessity follow the groups of industrial workers. For the factory workers, however, the migration to other regions is not going to be an unusual experience. During the past ten years there has been an average of just about one move for every industrial worker in the land. Indeed, the migratory character of our people, especially our factory employees, during the past decade has been one of the most astonishing economic facts of the times.

The atomic bomb, or rather atomic energy, is going to make the greatest changes in the human race in all the thousands of years since the discovery of fire. It is characteristic of any great change that it makes opportunities for some and takes them away from others. The cities of the Boston-Providence-Hartford-New York City-Newark

oval that cannot expand because of the peculiar way the five states are wedged together, like a jam of logs, and the cities elsewhere that could expand properly if they made a determined effort, but will not, are cities which should have opportunities taken away from them. All of these cities can expect to start losing factories by the dozens and population in droves.

A factory seeking another location must be assured, of course, that in the new location it will be safe from bombing attacks. Any other city bidding for this factory, but having not yet put its own self in order for atomic defense has nothing to offer it. But any city which will extend its boundaries to give itself a factory zone at its perimeter, with a wide belt between that zone and other parts of the city to be left free of buildings, and which will disperse its residences to a minimum of 2 acres to the dwelling unit, and by exercising its zoning laws through a permanently constituted zoning and planning authority is determined that it will never allow the population density in any section of its area to exceed 1000 to the square mile, has security from atomic bombing to offer the factory and to all employees and families that will follow it to its new location. Such a city, if it is ahead of most rivals in a race to be among the first cities to achieve civilian atomic defense, can expect to gain many new factories and industries.

In fact, no matter what factors in the past were favorable for the growth of cities, all now stand revalued and shrunken in importance before the terrible power and danger of the atomic bomb. For the years 1952, 1953,

1954 and 1955, therefore, it will matter but little how much climate, history and bustle a city boasts about. The one factor, surpassing in importance all other factors taken together, will be the assurance, promised in good faith, that it will not be a rewarding target for an atomic bombing attack.

5

THE WHEAT LANDS OF THE WEST

One of the very few things of which we can be completely sure about a total war, before it comes, is that no belligerent will fail to use any effective special weapon that has already been developed, if, presumably, more harm can be inflicted upon the enemy than is likely to be suffered in retaliation from the same weapon. Among weapons of this category is one about which, so far, not a great deal has been said. None of the special weapons, however, with the single exception of the atomic bomb, is more ominous for the future of the United States in wartime than the incendiary parchment. Though not an atomic weapon itself, the incendiary parchment can be carried by the bale loads to any region in the United States by any type of long-ranging plane that the atomic bomb has caused to be developed, and terrible damage can thus be inflicted.

The incendiary parchment is a product of British ingenuity of World War II, and details of its manufacture and prospective uses long since have been made public. It is a composition of phosphorus impregnated in a leaf

of combustible fiber about the size of a cigarette paper. So small is it, in fact, that thousands of sheets can be borne aloft in a single plane load. Dropped from high in the sky at night, when the air is cool and moist, the parchment floats gently to the ground, and there it will lie as inert as any other piece of paper so long as air and ground remain normally moist. But on a day when the sun comes out bright and hot the parchment, characteristic of a phosphorus substance, will ignite spontaneously. When this happens a flame shoots upward to the height of a foot, setting fire to dry grass or any other combustible matter near it.

Though tests with the incendiary parchment of World War II proved that it could be depended upon to withhold its spurt of flame until the spot where it landed grew dry and hot enough to allow the quick spreading of a fire, it was a weapon that could not be used effectively for the destruction of the ripening grain in Germany. This was because in Germany, as in other European countries, the reaping or binding method is used in the harvest. By this method the grain is reaped and bound while the stalk is still streaked with greenness. It is then piled in shocks in the field, where, during a lapse of three or four weeks, it goes through what is known as a "sweating" period, during which the processes of ripening and curing are completed. It is then ready for the threshing machine. Because in harvesting the grain is cut before its stalks become thoroughly ripe, there is little chance that a fire would spread through the field.

In the East, the South and parts of the middle section

of our own country, where summer moisture is not wanting, the binding machine is also used, and the grain is cut before its stalks are thoroughly ripe. In these regions, consequently, an incendiary parchment dropped into the midst of a field of wheat at the time of the ripening probably would not cause a fire to take hold. But in most of the wheat growing regions to the west of the Mississippi, where most of America's wheat is produced, it would be a different story. In these regions of semi-arid climate the grain is left standing in the field until ripe almost to the point of shedding its kernels. It may then be cut with a machine that reaps and winnows it, to be picked up from the ground, after only two or three days of drying in the baking sun, by another machine that both gathers and threshes it in one operation. In some of these regions, so arid indeed is the climate that no drying whatever after reaping is necessary, in which case the wheat may be cut with a header and taken directly from the spout of the header to the threshing machine. With still less trouble, it may be handled by a combine harvester, a machine that was developed especially for the grain fields of the semi-arid West, which circles a field of ripe grain, reaping and threshing the grain and spilling it into gunny sacks or grain wagons in one continuous operation.

Whether with winnowing, cutting with header and hauling directly to the thresher, or handling with combine harvester—any one of these three rapid methods for getting the grain into sack or bin is much more economical than the method which requires binding and stacking into shocks, because several steps of labor are saved and,

moreover, the cost of binding twine is saved. But the point is that these rapid and economical methods of harvesting wheat can be used only in those certain suitable regions, such as the semi-arid parts of the West, where the grain does not require a period of standing in the shock to complete the processes of ripening before it is ready to be threshed.

In a Western wheat region when a field reaches golden ripeness and is awaiting the machine for the harvesting, it is defenseless against an accidental fire. For instance, a lighted cigarette may be dropped from a passing automobile along the highway bordering the field. Among the parched grass where the cigarette happens to fall it is fanned into a flame. Once started, the flame spreads quickly across the shoulder of the highway, leaps into a field of wheat, and with roar and crackle, as uncontrollable as fire on the loose through prairie grass, it races across the field. In minutes all that is left of the golden field is a smoking ruin of black ashes. During a summer season in the West hundreds of fields of ripe wheat are destroyed in this sudden manner.

This accidental loss is only a very small sample of what could happen in time of war to the wheat regions of the West when the far-ranging planes of the enemy start coming over at night and turning loose over them millions of incendiary parchments. The next day after such a concerted raid, about the time the sun starts getting in its best licks and the wheat is as dry as tinder, here, there and everywhere the parchments would spring into life from spontaneous combustion. In a single day from a single

raid of planes all of the ripened fields in an area the width of several counties could be completely consumed by fire.

A suggestion for a solution, naturally, is that the binder machine should be brought into service to replace the present methods of harvesting the fields of wheat in the Western regions. The machine would reap and bind the grain before the stalks are thoroughly ripe, and allow the processes of curing to be completed in the shock, as is the practice in most wheat areas elsewhere. This method, however, would increase the cost of growing wheat considerably. In the dry lands of the West the bushel yield per acre for wheat normally is so light that it is only by harvesting the grain by an extremely economical method that wheat can be profitably raised. But even if cost of harvesting were not a deciding factor, such is the dryness of climate throughout most of the wheat areas of the West that the blades on the wheat stalks wither and parch in the sun before the kernels are filled. In these regions, consequently, the ripening wheat very probably could be destroyed by an incendiary raid even before the field was ready for the binder.

The introduction of "strip farming" into these dryland areas appears to be the only practicable means of saving them from destruction by an incendiary raid. Strip farming has already been experimented with and recommended for these dryland areas, not as protection against fires, but as a proved measure for erosion control. In these areas, unlike fields in the East, the soil is not sufficiently fertile to support a yearly crop. The normal practice is to put a

field to a crop of wheat one year, and the following year only to plow the ground and let it lie fallow for a season. "Summerfallowing" is the local term. Nitrogen from the air restores nourishment to the soil during the idle season. In the autumn of that year the field is seeded to a variety of winter wheat. When the fall rains come the grain sprouts, the roots are formed and go deep into the ground. Then comes frost, and the grass blades are bitten to the surface, and the field lies cold and barren, to all appearances completely without life, through the long winter night. But when the warm days of spring come, life in the wheat plant is revived, and soon the field is covered with a solid green carpet of wheat grass.

Typical of some of the wheat-growing areas of the West is the checkerboard pattern of the landscapes during the vegetation season—great rectangles of wheat, green or golden yellow according to the season, and an equal number of dark rectangles, which are the plowed summerfallow fields. As can be seen, a field which produces by this off-and-on method yields a crop of wheat only every second year.

When the infrequent rains which visit these parts do come it is characteristic of the country that, more often than not, they come in bucketfuls. In the fields that are lying fallow the water pouring from the skies sluices in muddy streams across the soft, plowed earth, carrying away from the high grounds and depositing in the valleys below the rich topsoil that a hundred years of mold and decay, trace by trace, had been putting there. It was in search of a way to stop this impoverishing loss of the top-

soil that the strip method of farming was developed by agronomists.

By this method, instead of planting an entire field to wheat and allowing an entire adjoining field to lie fallow, a contour of wheat several yards in width is planted, an adjoining strip of equal width is passed over, to be plowed and left to lie fallow, and then another strip is seeded, and so on, until the field is covered with alternating contours of sown ground and fallow ground. After this has been done, a stream of rainwater breaking across a plowed strip has its muddy flow slowed by the first vegetated strip it must cross. The slackened water is given time to soak into the ground, depositing its load of topsoil among the grass roots instead of carrying it off into the valley to become forever lost. The next year the same process is followed, except that the strip that was in wheat the previous year becomes the summerfallow strip, and the strip that was idle becomes the crop strip.

An improvement on the foregoing method which has been experimented upon with success in some regions is the planting of an animal legume, such as soybean or field pea, on the strip that otherwise would be lying fallow. It is the special ability of the legume, almost alone among the numerous species of plants, to take nitrogen from the air and put it into the soil for the use of subsequent crops. By using this plant for this purpose nourishment can be restored to the soil as well as it can through allowing a field to lie fallow for a year, or even better. In addition to this, the legume is a profitable crop, having a high feed value for livestock.

Though strip farming was developed as a method for erosion control, the same method could now serve effectively to protect a field of wheat from an incendiary raid. A fire getting started in any contour of the ripened grain could burn its way only to the edge of the strip. There the plowed ground or the green crop of legume would be a barrier to its spreading beyond the one strip where it got started. The area that a single incendiary parchment might destroy could be further decreased by plowing furrows at right angles across the wheat strips or by cutting lanes of hay across them before the stalks have turned ripe.

In the long time since strip farming was first tried out on a number of farms and its value in erosion control demonstrated, there has been no general adoption of the method by the farmers whom it could benefit most. It appears that this is true only because farmers are no prompter than others in responding to new ideas. There is little hope, therefore, that the wheat growers of the semi-arid West will voluntarily put strip farming into practice in time to protect their fields of grain from the incendiary parchment. Indeed, when in the big cities new skyscrapers, new industrial plants, tall apartment houses and other immense structures continue to rise, despite the fact that almost daily some responsible person is telling these cities that they will be targets for the atomic bomb, it is too much to expect that farmers, whose lives will be the safest of all when the next war comes, will be frightened into taking action entirely of their own accord against the threat of the incendiary parchment.

The fact must be faced, therefore, that if strip farming

is put into practice for the purpose of saving the nation's supply of bread when the next world war comes, the federal government will have to step in and require that it be done as a measure of national defense. This the federal government has the power to do not by resorting to police action, but by the simple process of allowing price support on wheat in the semi-arid regions only on crops grown on farms where strip farming is used.

Without going into the plans for price support on crops that have been used already, and the various other plans that have been proposed, and without taking sides in the present arguments among farmers and others over the merits of any certain plan, it can be said that price support on crops is defensible in principle. Furthermore, it can be said that there will be price support on crops in one form or another during the present year, next year and for as many years in the future as anyone can foresee at this time.

But if price support on crops is allowed as a sound principle, another principle that must not be forgotten is that a rule is a poor one if it will not work both ways. If the federal government by price support on crops must insure a farmer against ruinous losses due to falling markets, in return it would seem that the government has the moral right to require the fulfillment of any reasonable requirement connected with crops that will be in the interest of the farmer's own welfare as well as in the interest of national defense. Applied to the subject at hand, this would mean that in any wheat region where strip farming is decreed by a proper executive order, any farmer failing to put it into practice would be denied price support.

6

THE FORESTS OF THE WEST

When the war planes come over the ocean and loosened bales of incendiary parchments flutter down from the skies like millions of election handbills caught in a whirlwind, more difficult than the problem of the wheat fields of the West will be the problem of keeping whole areas of the national forests from going up in smoke and flames. Again, as in the case of the wheat fields, it is the forests in the West that must suffer the greatest harm. In the East the forests are a mixture of conifers and broadleaf trees. The latter are not so easily attacked by fire as are the resinous conifers, and in course of time have grown natural firebreaks through the forests. In the deep South the forests are mainly turpentine-producing longleaf pines, easily attacked by fire wherever fire has a good chance for spreading from one tree to another. But in the South grows a fire-tolerant grass interspersed among the forest trees and giving protection to them. In the West there is little of either broadleaf grove or fire-tolerant grasses to give protection to the resinous pine and fir abounding there.

Moreover, the forests of the West are more at the mercy of a dry summer climate than are the forests of the East and South. In the West it is usual for precipitation to fall during the autumn, winter and spring, and almost none at all during the months of summer, when it might do the most good. An example is the Pacific Slope in Oregon and Washington. This region is popularly supposed to have a wet climate. Actually the annual rainfall is around 40 inches, which is about the same as for upstate New York. But the difference between the two regions is that, whereas in upstate New York normally six inches of rain fall during July and August, in the Northwest barely more than an inch falls during these two hottest summer months.

Along the coasts of Oregon and Washington, during the long summer drought the forest becomes so dry that no more than an accidental spark is needed to set whole areas roaring in flames. In this region the camp fire that has not been thoroughly extinguished when abandoned, the uncrushed cigarette butt and the unbroken match stem are blamed for most of the fires. But they are not the only causes. It has been estimated, for instance, that lightning striking trees and setting them on fire is responsible for at least ten per cent of the fires in the region. Whatever the sources, the danger is so great that hundreds of foresters keeping watch over the vast areas from high towers and from airplanes, are not able to prevent an appalling annual loss of good timber.

If no measures beyond those presently employed are taken for the protection of these forest areas, one shudders to think about what will happen when enemy planes un-

loose tons of incendiary parchments over them. No matter how damp the forest may be when the parchments are dropped, they will lie in wait for weeks if necessary, until the area is thirsting with drought. Then they will spring into life. Soon the whole forest area will be one vast furnace of flames and the sky for miles around will be filled with clouds of dense smoke, blotting out the sun.

Yet there once was a natural means for protecting these magnificent groves of the West from fire. When the white man first visited them a century and a half ago, then, as now, there certainly was the possibility that a forest fire could be started when a bolt of lightning sank its fangs into the pitchy top of some dying monarch of the forest.

At that time, the Indian was the only inhabitant of these forests. By all accounts he was a man of enviable physical prowess. He could travel tirelessly through the forests from daybreak to nightfall, bow and arrow in hand, on the trail of a buck. He could swim like an otter, throw from a high precipice a gig into a salmon resting at the bottom of a pool of water far below, shoot an arrow straight to the mark, and guide a canoe through the rapids as if it were a bridled horse. He was a wrestler, too, and they say he would not hesitate to bet his best horse to a white man that he could throw him at Indian style of wrestling. But with all of this energy bursting out the seams of his buckskin breeches the Indian of the forest never spent any of it stomping out a forest fire. That for him would have been work, something in his nature to be despised as much as hunting, fishing and wrestling were loved. It is safe to say that the idea of fighting a forest

fire never once entered the mind of the Indian. On the contrary, he sometimes sent his squaw to apply a fire brand to the forest to burn off an area where young grass would later sprout and give grazing land to the cayuses belonging to the tribe.

If it can be explained why these great forests of the West, which presently require constant watch throughout the summer months by an army of foresters with fire-fighting equipment, could not be destroyed by fire back in the days of the Indians who never got up off their haunches to put out a forest fire, we might find a way to protect these same forests, not only from the danger of an incendiary raid, but also from the destructive fires that visit them during ordinary seasons.

The strange fact is that all of the forest areas of the West in what are now Washington, Oregon, Idaho, northern California, Montana, Wyoming, Utah and Colorado, once required no watch or forest fire equipment to keep them from burning down because all of the streams and tributary streams were cross-dammed and flooded into ponds and swamps right up to the tops of the mountains. Between every two small ridges the cross-dammed streams constituted an effective fire break. Moreover, the water spreading into wide ponds and swamps kept the adjoining fringe of forest damp with dew. The creature responsible for this cross-damming was the ingenious and industrious little beaver, once the inhabitant of every forest stream of the West.

It was the misfortune of the beaver, and the misfortune of the forests of the West that his pelt was so highly prized.

Many years before the Louisiana Purchase gave the United States a window on the Pacific the French *coureurs de bois* had pursued the beaver westward across America. It was they who left French names upon so many lakes, streams and mountains of the Northwest—Coeur d'Alene, Pend Oreille, Touchet, Maries, Culdesac, to name only a few. After the French rights to the Northwest had passed by purchase to the United States, John Jacob Astor's American Fur Company, the Northwest Fur Company, the Missouri Fur Company and other American and British fur companies crowded into the Northwest; and principally it was the pelt of the beaver that built the fortunes of these companies. Many years before the excitement about gold took hold of the West, the fur trappers had had their day there, following the mountain steams to their sources with their chains of traps. Every forest stream down to the smallest was exploited for its peltry. Before such rapacity the little beaver had no chance. Within a generation and a half after the Louisiana Purchase opened the Northwest to a trade war between the many rival fur companies, both American and British, the beaver was all but extinct.

In recent years much has been done toward restoring colonies of beavers to the mountain streams of the national forests of the West. Wherever replaced and given proper protection the little animal has steadily multiplied. It is again cross-damming the streams with its clever dam of felled trees, sticks and mud, causing the water to spread into ponds and swamps. One has only to stand upon a mountain in western Colorado and look down into a valley

and see its floor completely flooded with water, and a network of dams intersecting the valley (which a stranger could easily mistake for the works of man, such as a series of rice paddies), to catch a vision of what the forest areas of the West must have looked like before the fur companies all but extinguished the beaver. Every valley that is dammed and flooded in this manner forms an effective firebreak between one forestclad ridge and another. Also, the water spreading over wide areas keeps the marginal soil subirrigated, the evaporation of water from which, as well as from the wide pond surfaces, keeps the forest throughout the entire valley damp with dew.

A program for re-stocking the national forests with beaver must be stepped up, to the end that all of their streams, down to the tiniest, once more will be cross-dammed throughout their lengths and the water flooded over wide areas. There is every reason to believe that when this has been accomplished fire will have no better chance of destroying the forest than it had back in the days of the Indians. At the same time, the beaver, by the thousands of dams it builds, is bound to contribute greatly to flood control and to the underground supply of water for pipe irrigation, of which more will be said.

But the time before probable attack is too short to get enough colonies of beavers transplanted and multiplied in numbers great enough to build the tens of thousands of dams the forests will require to make them fire resistant. The work of transplanting the beaver must be continued, but at best it will have to be regarded as a long-range program.

What must be done against precious time, therefore, is to give the Forestry Service additional funds to complete building fire lines along the divides and principal lateral ridges of the forest clad mountains, and funds for equipment and labor with which to drag heavy logs from the slopes and lay across the streams. The fire line will assist in preventing a fire from spreading from one valley across a ridge into another valley. The log dam, by causing the water to spread, will serve to stop a fire from crossing from one side of a valley to the other side of the same valley, and it also will serve to keep the forest damp with dew. In short, the fire line and the log dam together can temporarily provide the protection from forest fires that the beaver dam alone can later make permanent.

There is another means of protecting the forest areas of the West from fires which no doubt will soon be more extensively used. It is rain making by the process of seeding the clouds from a plane with silver iodide crystals, causing them to give up their moisture. But of course there can come from the skies no more moisture than the sun in its labors can suck up from the oceans and moist soil, to be carried onward by clouds on the wind. If rain is caused to fall over one area by this artificial means obviously its fall is at the expense of normal rainfall in other areas.

If artificial precipitation does become dependable as a fire preventive during ordinary seasons, it could, of course, be used to protect the forests from incendiary parchments dropped by the enemy. But here, unfortunately, is a promised cure that could provoke a danger far greater than the

disease. If our government can give thought to milking the clouds to produce a rain that will prevent the enemy's incendiary raids from destroying our forests, so also could the enemy produce drought in certain of our regions by causing their normal rainfall to fall elsewhere. In fact, no scheme of the enemy for hurting us badly could be more easily carried out than for him to send his planes into the areas of the Pacific and Atlantic oceans and the Gulf of Mexico, seeding the clouds with a rain making chemical, causing them by this means to give up their moisture before they have been swept by the winds across the continent. This could turn areas along the Atlantic seaboard, the Gulf states, and the Pacific Coast into Saharas.

Fortunately, however, every chemical has its re-agent. Any threat of the enemy to turn our continent into a desert can be met by our government, if it is prepared, by keeping the skies over the oceans in wartime dusted with a chemical that will neutralize whatever chemical the enemy might spread.

It is true that the idea of beaver dams and impounding of water on the farms will be opposed by those who have been draining swamps for the purpose of mosquito control in areas where malaria is prevalent. The work of these people cannot be too highly commended, because of all diseases malaria is the worst. It shortens the life, kills and destroys the mental faculties of more millions of people than any other disease. In all the world there is no flourishing civilization in an area infested with malaria. But the drainage of swamps is not the proper method for obtaining mosquito control.

As the mosquito is an insect, entomologists should use other insects to destroy it. The proof that this is possible is the fact that there are areas where there are no mosquitoes of any genus, though there are ponds and pools of stagnant water and all the other usual conditions ideal for breeding. One region is in the Blue Mountains of eastern Washington. It may be that in those areas it is the water strider that destroys the larvae of mosquito. Or it may be an omnivorous water bug that feeds habitually on algae and incidentally on any larvae that come its way. Whatever the cause that keeps certain areas free of mosquitoes, it should be found and introduced into the mosquito-infested areas. Surely the entomologist who is the first to do this will have done a greater service to humanity than any other man of his generation.

7

WHEN THE BIG DAMS GO OUT

A PROBLEM more difficult than either wheat field or forest region of the West is the problem of keeping the nation from becoming crippled, almost beyond its power to recover, when the colossal river dams now built are tumbled into the gorges in great chunks of ruin. All of these big dams are vulnerable. What New York, Chicago, Philadelphia and some forty other names are to the big cities, so Grand Coulee, Hoover, Shasta and some forty other names are to the big dams. The immense sizes of these dams and their economic importance to the nation single them out as targets against which the enemy can afford to send bomb after bomb until all are destroyed.

Obviously, dispersion will not protect a dam already built. Once the concrete for a dam has been poured, the dam cannot be reduced in size. But the large dams, or more properly speaking the electrical power they are producing, can be replaced from hundreds of smaller dams, none of which must be built so large that it can be singled out as a rewarding target for an atomic bomb.

If a city whose population does not exceed 15,000 will

not be a target for atomic bombing, certainly a hydroelectric plant serving the same city with power and light will also be safe, because the loss of the plant could distress and cripple only the industrial output of the people it serves, but not destroy them. Neither does it seem that a hydroelectric plant to serve several communities totaling 25,000 or 50,000 population, but no important war industry plant, could possibly be a profitable target for atomic bombing. But a hydroelectric plant with a capacity to serve as many as 100,000 people, or an important war industry plant, almost certainly will be marked by the enemy for destruction by an atomic bomb when opportunity and priority permit.

When hydroelectric power is the sole purpose for damming a river there seems no good reason why it would not be better to build several dams in series along the same river rather than put all the investment and risk into a single large dam. If in a distance of 100 miles a river drops 200 feet, a dam 200 feet high built at its lower end will, of course, form a lake the full 100 miles long, and will harness every ounce of potential horsepower of the river for this distance. But five dams built in series on the same river, each with a spillway of 40 feet, and spaced so that the foot of any one dam, except the lowest one, is at the water's edge of the lake formed by the dam next below, will capture all of the potential horsepower of the river as effectively as can a single dam with a spillway of 200 feet. It is also true that less concrete and structural steel are required to build five dams in series, each 40 feet high, than to build one large dam 200 feet high on the same

river. That is because the higher a dam grows the greater becomes its length, measured at the top, and the wider becomes its base.

What is true about the size of a hydroelectric plant is also true about a steam plant. If a hydroelectric plant serving 100,000 people becomes a profitable target for atomic bombing, so also will a steam plant of that capacity. And just as the defense of the hydroelectric plant is to divide its capacity among several smaller plants, so the defense of the large steam plant is to replace it with several scattered plants.

Failure to protect both the hydroelectric and steam plants will mean a major disaster for the nation. No matter how widely manufacturing plants are dispersed to make them safe from atomic bombing, they will, nevertheless, be standing as idle as wrecked buildings if electric current cannot be kept flowing to them.

This danger can be averted if all the facilities for generating electrical power in each of the large geographical regions are consolidated under a single utility authority which will erect a number of dams in series and steam plants properly dispersed. None of these would be a large enough target for atomic bombing, but the total of their mutually supporting capacities would produce in time of war, as a minimum of performance, enough electric current to keep in operation all of the important war industry plants and also supply electricity for other highly critical purposes.

These regional utility authorities may be either wholly government owned, or wholly privately owned, or part

one and part the other. If the public is fearful that private ownership may lead to power monopolies, Congress may require an organization similar to that of large corporations such as the American Telephone and Telegraph Company, the stock of which is owned by so many thousands of shareholders that the ownership amounts to public ownership. Right now, however, the question of ownership is not the important thing. The important thing is to get these regional authorities organized as quickly as they can be, and get started with the work of constructing the dispersed hydroelectric and steam plants.

Whatever the type of ownership, each of these large regional utility authorities, extending as it will over more than one state, must, of course, be under the control of the federal government. The building of a large number of scattered plants and the necessary high-tension lines to make them mutually self supporting within each geographical region, will be primarily for the purpose of national defense. Hence, no matter how owned, the cost of construction must be borne by the federal government.

The building of dams in series and the decentralization of steam plants can prevent the loss of critical amounts of the nation's supply of electricity when war comes. The generation of hydroelectric power, however, is not the sole function of the larger dams. Other functions include flood control, navigation, river regulation and water supply. In fact, a few of the large dams do not produce any electric power.

A dam 200 feet high will create a lake impounding far more billions of gallons of water than can five dams, each

40 feet high, built in series on the same river, and will provide flood control and generate as much power. If the purpose of the dam is to supply irrigation water, a dam 200 feet high may be required to lift the water to this height before it will flow by gravity onto the land to be watered. A hundred dams in series, if each is less than 200 feet in height, could not perform this function of the one large dam.

The auxiliary value of any dam as a means for flood control is now being sharply questioned. If the lake which the dam creates behind it is already full of water when the flood season starts (which is the usual case), the increased flow of water simply spills over the dam and goes surging on its way. Except for the water which sinks into the ground beneath the lake, not a gallon is held back by the dam. In order that a dam may serve effectively for flood control and also generate hydroelectric power, it must have a superstructure above the water level which provides power. There must be gates in this superstructure which can be closed to give the lake formed by the dam a greater depth for water storage whenever a flood season is on. Not many dams have been so constructed.

Power dams built anywhere in the Mississippi Basin are not trustworthy means of flood control. The Mississippi Basin is the nation's greatest flood problem, receiving as it does water from thirty-one states. Yearly the Upper Mississippi and the Ohio become swollen in flood. When the flood stages of the two rivers happen to come at the same time, a disastrous flood is inevitable. Above the point

at which the Ohio joins the Mississippi the water of both streams is rolled back for miles until it forms what in effect are two enormous lakes, overflowing the natural banks of the rivers, and causing great loss of lives and damage to property every few years.

From a point a short distance below where the Mississippi is joined by the Ohio the greater river starts meandering. It becomes not merely serpentine in shape but in places loops back upon itself to pass only a few yards from a landmark it passed hours before, flowing in the opposite direction. Because of this turning and doubling back of the river below the point where it seems uncertain about which way it wants to flow, its course to the sea covers some 2000 miles instead of a straight course of only 600 miles. These 2000 miles of crazy winding and turning form in effect an enormous dam, blocking the water for miles above it.

As the rate of water flow in a river depends mainly upon the amount of fall, if the channel of the Lower Mississippi were straightened and shortened to less than half of its present meandering length by cutting wide canals through the narrow necks of land separating one great loop from another, the rate of flow would be so greatly increased that no enormous lake of water could be formed above the point where the river now is obstructed. Fortunately, the government has at last started upon a project for such canalization of sections of the lower reaches of the river. When this work is completed the increased rapidity of flow will give the water a chance to escape to the sea during seasons of flood instead of

spreading over farms and villages. This canalization of the great river will do more for flood control than has the building of dozens of dams across the tributary streams. Furthermore, dams built to control floods can be destroyed by atomic bombing, but a canalized river channel is one of the very few works an atom bomb can not destroy.

Flood control for the great river could be furthered if the government will link the impoundage of water on thousands of farms in its basin with price support for crops. So, too, could control be helped by the construction by man of thousands of log dams in the forests, to be replaced later with the dams built by the beavers. One of the virtues of a pond, whether artificial or natural, is that it causes water to sink into the ground, to seek its way to the ocean through underground channels.

Another means of flood prevention is the growing of grass on the watersheds, which, many leading agriculturists and conservationists insist, is the best means of all because the grass stops the water where it falls from the sky. And strip farming, which will save the semi-arid wheat fields of the West from incendiary peril, will also contribute greatly toward flood control.

Even if the big dams were the most effective means for flood control, dependence upon them must now be abandoned. If this is not done, and the work of constructing more big dams is continued, the cities and farms along a river are going to suffer their most disastrous flood of all time when the dams are destroyed by bombing.

It is in the West that the greatest damage and suffering will be caused by destruction of the great dams, because in that region most of the big dams which generate hydroelectic power also supply water for irrigation. The pipe or sprinkler system of irrigation which is rapidly coming into use in many places will be much less vulnerable to bombing attack than the old ditch system.

The usual method for reclaiming the arid lands of the West has been the ditch system of irrigation, first extensively used by the Mormons. By this method water is carried from a dammed river or creek through a system of canals to the dry land. At the field the water is flooded over the surface or, more often, carried across the field through hundreds of small corrugation furrows spaced about 30 inches apart. The land irrigated by this method must be land that is level to start with, or which can be leveled by scraping down bumps and filling small depressions. Also, the land must be free from large stones. Because the ditch system is limited by any ruggedness of the ground, a familiar view of an irrigated region is that of a broad valley or plateau of choice land, flat as a hand, glistening in the sun with irrigation ditches, and fruitful with crops and orchards, which is surrounded by brown, parched hills, still as much desert as they ever were, because their ruggedness prevents their being watered by the ditch system of irrigation.

But no matter how rugged a hill may be, if water can be brought to its top, it can be irrigated by the pipe system of irrigation that has only recently come into use. By

this system the water is carried from a stream or piped from a well or other source to the field through a system of pipes and sprinkled over the ground as water is sprinkled over a lawn. By one method, the irrigation pipes are laid under the ground, and when the water is turned on it is sprayed from the pipes through dozens of taps equipped with nozzles. It is by this system that many of the golf courses throughout the country are watered. By a more recent system, however, and one far less expensive to install, only a few taps are required for a field. From one of these taps the water is carried by a hose which is connected at its lower end to a moveable sprinkling pipe, a hundred yards or longer in length, mounted on wheels. This odd-shaped, elongated sprinkler is a single piece of equipment, and because it can be moved to any part of a field it can water a larger area than dozens of underground pipes and nozzles, and at much less cost.

Pipe irrigation as compared to ditch irrigation has many important advantages. One of these is that it can be used on rugged land as well as on level. Another is that the amount of water is only about a third of that required for the ditch system. Another is that sprinkled water soaks into the soil like a gently falling rain, and consequently does not leach the soil of its minerals and nourishment as does water flowing through the corrugation ditches. Indeed, the only important disadvantage of the pipe system as compared with the ditch system is the initial cost of installing the pipes. But this is a cost which has already been so greatly reduced by the use of the moveable sprinkler that today in many regions a system

of pipe irrigation is only slightly, if any, more expensive to install than a ditch system.

At first it might seem that any considerable expansion of the pipe system of irrigation would put a heavy strain upon the supply of iron ore, of which presently so much is required in the expanded national defense. But it has already been discovered that hematite, a low grade of iron ore, can be used for the manufacture of the large arterial pipes. Hematite is found in abundance in many regions of the United States, and recent discoveries of methods for processing it at a low cost probably will make it available for all the large pipes that would be required for putting the millions of acres of rugged and arid lands of the West under pipe irrigation.

When pipe irrigation comes into general use it can reclaim much larger areas of land than is now under ditch irrigation in the West. The water will be lifted from rivers, creeks and drilled wells, and can be pumped from low ground to a higher level without building costly dams. Even in many areas where the ditch system already is in use the pipe system is bound to replace it, because the pipe system requires far less water and it also has the merit of not washing nourishment from the soil.

The greatest use of the pipe system on a large scale will be in areas where the ditch system has not been useable because of the generally rugged character of the terrain. Throughout most of New Mexico, Arizona, West Texas and large areas in Colorado, Wyoming, Utah, Idaho, Nevada and California, and sections in other states, the land, except in the valleys, is too rugged for ditch irriga-

tion and too arid in its natural state for any use except light grazing. But under these magnificent hills, which are bronzed and parched during the summer, or purple with the desert-loving sage bush, flow underground streams from the distant snow-capped mountains, awaiting only to be lifted to the surface and spread over the face of the earth with sprinklers.

When there has been more cross-damming in the mountains, which there will be when the streams have been re-stocked with beaver, and when there has been more impounding of water on the farms, more growing of grasses on the watersheds and more farming by the strip method, the underground supply of irrigation water will become more plentiful. Much of the same water that is now flowing down the Mississippi, the Rio Grande, the Colorado and the Columbia in seasonal floods can, by the various means for causing water to sink into the ground, be sent off to the oceans through underground courses, to be tapped on its way by wells, lifted to the surface with pumps and spread over the rugged hills by means of moveable pipe sprinklers. When that day comes there will be areas of the West where the hills can be kept as alive and beautiful with grass throughout the months of summer as they now are during the weeks of early spring—and perhaps in nature there is no sight more beautiful.

Although the sprinkler system of irrigation can bring water to millions of acres of arid land of the West that the ditch system is not capable of reclaiming, the rugged and stony nature of most of the land will allow the growing only of grasses, not the raising of cultivated crops.

This is something not in the least to be regretted. On the contrary, the fact that only grasses can be grown on the newly-watered land should be regarded as a godsend, because the growing of an abundance of grass will mean the production of more beef, and it is more of this class of food which our nation at present is most in need.

It is a fact that has been observed by many prominent agricultural specialists that the beef production in our nation was in a far better balance a couple of generations ago than it has been since. At that earlier time in the West there was an abundance of open grazing land. Cattle could be raised cheaply on the native grasses. When they had grown to mature age the cattle were bought on the hoof and shipped eastward in carload lots to the feeding pens, to be fattened for a few weeks on the corn of Nebraska, Iowa and Illinois, and then slaughtered. The cattle growers of the West, although receiving in places no more than two cents a pound for their steers on the hoof, were relatively better off than the cattle growers today. Indeed, in those days some of the herds roaming the unclaimed lands of the West made fortunes for their owners, not because of good hoof prices but because about the only expenses in the business of raising cattle were the wages of the cowboys and the cost of their chuckwagon chow. As an example, there was the fabulous 101 Ranch in Oklahoma which shipped to the market each year thousands of head of cattle from grazing lands rented from the Osage Indians at only a few cents an acre. The farmers of the corn states, whose corn went to fatten the range-grown cattle at the fattening pens had a good market for

their corn. Although its bushel price was, of course, much less than the present market price, relative to other prices of the period it was good. But the best result was that beef at that time was no more expensive than other food. Those were the days that many can remember fondly when a juicy beefsteak ordered at an ordinary restaurant overlapped the platter, and cost a quarter, including side dishes and coffee. In those days, which now may appropriately be called the Beefsteak Age, a housewife who paid more than 25 cents for enough beef for a meal for her family was being just a little extravagant. The beef of that period was not merely cheap because all food prices were then much less than they now are, but also because the cost of raising beef on the grass ranges of the West was scarcely more than earlier it had cost the tribes of Indians in the same regions to hustle their meat from the herds of wild buffalo.

But about 1900 the balance between grasslands and cultivated lands began to change, with more and more of the grasslands being turned over to cultivation. The process was hastened greatly during the period of the First World War, when the price of wheat was bolstered by the government to encourage greater production. Thousands of ranches in the West were induced by the exorbitant bushel price to plow up their grasslands and sow to wheat. All went well while the war lasted, and for a few seasons afterwards. Then the bottom dropped out of the wheat market. In the meantime the grasslands had been stripped of the sod that had required centuries to grow. It could not be restored. Seasons of drought then came. The soil

was blown into the skies. The Dust Bowl was created. Thousands of ranchers who once had been prosperous were ruined.

But the greatest harm of all was the upset of balances between the meat-growing lands and the cereal-growing lands. The grass-grown livestock census went down. With less grass-grown livestock being produced, the requirements for feeding grain were less, and its price dropped. By those who at the time were trying to wrestle with it, the problem was called overproduction, and the solution was thought to be planting less, plowing up every other row, and taking other pages from the philosophy of scarcity.

In proportion to the increase in the nation's population during the past fifty years there has been a third decrease in its cattle, but it has been due not so much to the decrease in supply and the increase in consumers as to the upset of balances between grasslands and cultivated lands that during the same period the prices of beef on the hoof have increased more than a thousand percent. Most of the beef cattle do not now come from the once limitless grasslands of the West, but are raised on farms, where the cost of raising is high and compels selling off the animals while still weanlings and yearlings. On the farm a calf from a day old is sucking milk that is worth a good price, and the little critter must be allowed several quarts a day to keep it from bawling. When old enough to be weaned from milk it turns around and starts eating its head off from the corn crib and the hay mow. By the time it is ready to be sold for slaughter, if the price received is not enough to

make up for all the gallons of milk it guzzled as a youngster and all the corn and fodder it later ate, the farmer has lost money raising it.

It has been computed that in the raising of a vegetable food, as for instance lettuce, a single county could grow enough for every table in the United States. A single county in Maine actually does grow a good part of all the potatoes eaten in the East. But the production of beef is a different problem. Beef is a highly concentrated food. To raise a single steer to maturity requires the foliage growth from several acres. If there is not an abundance of grasslands and beef must do its growing on cultivated crops, the cost of raising it cannot be other than high. That is the difficulty at the present time. Farms are for the growing of cultivated crops, for dairying, for raising hogs, for producing poultry and eggs, but for the growing of beef —no.

The way back to an abundance of beef is for our government to do its part toward reversing the processes that have been causing beef to rise to skyrocket prices, yet without bringing better profits than formerly to the cattle growers. This the government can do by increasing the productivity of the grasslands of the West by means of pipe irrigation. Those rugged, stony hills that presently are too arid to produce anything more than scant vegetation can, by means of pipe irrigation, be converted into millions of acres of the sweetest, most nutritious grasses that have been grown anywhere.

Let only these areas be apportioned among 320-acre perpetual homestead ranches (to be discussed at length in

a later chapter), and from government loans let there be financed the water companies that can bring piped water to these lands, and once more there will be millions of head of grass-grown, mature beef cattle moving yearly to the fattening pens, to be fed for a few weeks on corn, to give tenderness and flavor to the flesh, and then slaughtered. The farmers of the corn states will receive good prices for their corn. Yet because the steers will have spent all but a few weeks of their lives on the grassland areas, carcass beef can be sold cheap, with profits to all concerned in its production. Once more housewives will be able to buy steaks and roasts at such reasonable prices at the meat counters that they can, if they wish, give their families beef in some form every day of the week.

A national project for creating tens of thousands of perpetual ranch homesteads from the arid lands of the West, watered by pipe irrigation, green with grass, increasing by millions the beef cattle census of the United States, and giving homes and colorful ranch life to tens of thousands of families, will offset by a good margin the food that will be lost when the big dams now furnishing water for ditch irrigation are destroyed by atomic bombing. But, obviously, these new projects for pipe irrigation will be doing nothing to furnish water to the farms now irrigated by canals which take their water from the big dams that are doomed to destruction.

However, because a forage crop, such as alfalfa, is the ideal crop for pipe irrigation, and the water needed is only about a third that needed for ditch irrigation, on many of the farms now watered from canals there can be a hope

that eventually pipe irrigation will take over. In fact, had the iron tube arterial pipe, the improved pumping machinery, the moveable sprinkler and other accessories of the pipe system been available years ago, many of the areas reclaimed with canals could have been reclaimed at less cost with pipe irrigation.

In some places there is normally enough water from the skies to produce fair foliage and only a few additional inches of water from the sprinkler should be required to grow grass in abundance, but in other places the rainfall is so light that twelve or more inches of irrigation water would be required. In some regions creeks and rivers are close by, from which irrigation water may be pumped and piped at little cost, and in other regions that is not so. In some regions good flows of well water may be obtained by drilling to a depth of a hundred or two hundred feet, and in other places wells sunk to a thousand feet cannot reach good veins of water. The whole subject, in short, is complicated by so many factors that no general statement can be made beyond saying that many of the farms presently watered by ditch irrigation can be saved by changing to pipe irrigation before the big dams doomed to be knocked into pieces from atomic bombing go out, and there are many others that are not so fortunately situated.

8

STOCKPILES OF MINERALS

The nation's deposits of metallic ores are not, of course, consumable by fire, as is a field of ripe wheat or a forest of resinous pine that has not had a drop of rain in many weeks, nor are they destructible by demolitions, as is a dam of concrete. Nevertheless, the heavy machinery required to scoop out the ore at the mine pits and load it aboard trains and the large smelters that reduce the ores would be rewarding targets for bombing. Besides, the ore mines are in danger of being neutralized from radioactivity contamination.

Most vulnerable of our domestically produced ores is iron, the one unhappily upon which war preparedness must chiefly depend for its weapons and implements. An estimated sixty per cent of this iron ore comes from a single mound that nature in one of her most freakish moods built millenniums ago at the center of an encircling chain of lakes. The mound is in northern Minnesota, barely inside the border of the United States, and is known as the Mesabi Range. Scooped from the open pits by herculean shovels, the ore is given a short haul by gondola cars to Duluth and there dumped into long, lean ore boats,

which cross the length of Lake Superior, squeeze through the locks of Sault Ste. Marie, and once in treadable water again point for the ports that serve the furnaces of Detrait, Gary, Pittsburgh, and other steel manufacturing cities. Such is the enormous output of ore from this one unique mine loaded out at Duluth that it gives that city, which stands two thousand miles by lake and river from the ocean, the strange distinction of being in point of tonnage shipped the second port in America, next only after the port of New York.

Raids upon the open pits of the Mesabi Range for the purpose of destroying the ore lifting machinery and sowing the area with deadly radioactivity, almost certainly could not be denied a determined enemy. A mission easier still for him would be the destruction of the locks of Sault Ste. Marie, the only outlet for the ore boats from Lake Superior.

The Mesabi Range is the greatest of the ore deposits, but by no means the only vulnerable one. The Copper Bowl in Arizona, the open pit copper mine at Bingham, Utah, the copper mines near Butte, Montana, and many other highly centralized ore investments could be blasted with atomic bombing, paralyzed and put out of commission for the duration of the war.

Because of the danger which threatens our domestically produced metals, a program is required for the mining and placing in dispersed stockpile storage, as dressed ore, pig, and metal rolled into sheets and various other stock products, the quantity of each metal that is likely to be required during a war of long duration. The prices of these

metals, though high now, are cheaper than they will be if we wait until war is upon us before starting to dig their ores from the ground. Moreover, the man power to mine and smelt, or even to mine and stockpile as ores, we are more able to furnish now than we shall be after 15 million able-bodied men have been taken from civilian life and put into the armed forces. But the primary argument is that only by getting our metals out of their highly vulnerable mines and getting them scattered into stockpiles can we be sure that the enemy's bombing attacks will not completely deprive us of them.

Stockpiling has given to war a dimension in depth, making it possible for a nation to achieve war effectiveness far beyond its yearly potential yield of resources. The subject is important in the extreme.

After many years of persuasion from a small group of men who have long been greatly interested in the subject, and after some very bitter experiences during the recent war, our government has at last become convinced of the necessity of stockpiling various strategic minerals. A strategic mineral has been defined as one for which dependence must be placed in whole or great part upon foreign sources. Among these metals are tin, nickel, manganese, mercury, tungsten, chronium, antimony, platinum, and some others. But the present program for stockpiling strategic minerals, large though it is, still is not sufficient to save our nation from becoming seriously crippled in time of war in case the countries from which these strategic imports are received should soon be knocked out of the war effort, as many of them probably will be.

As many of the nations of the world which now are counted among our friends expect that we will furnish them with war equipment and financial assistance, even in greater measure than at present, in addition to our standing ready to mobilize, train, equip and send overseas an expeditionary force of five million soldiers, it does not seem unreasonable that we should get from these nations, in return for the money we loan them and the military equipment we will turn over to them, all of the strategic minerals they can spare, the value of each shipment to be credited against the loans of money and the equipment we furnish such country. Not only should we obtain in this way shipments of strategic minerals from the countries we are aiming to support, but also we should receive from them all of the iron, copper, zinc and lead that can be spared, in order to increase our own stockpiles of these metals. Whatever metals are turned over to us, whether they are among the strategic items or not, certainly will later have a better chance for becoming converted into ammunition, guns, tanks and planes, which we will share with our allies, than they will if left as ores in the mines of the countries that are in danger of being overrun by the enemy. All of the metals received in this manner from overseas would not be causing our country to compete on the metal markets with the countries from which they come, because they would be stockpiled by us, to be held strictly in war reserve storage.

But should there be reluctance in these countries to give up to us quantities of their minerals in this way, preferring to have our money and our machinery as outright gifts,

and expecting us to pay in cash for whatever items the returning ships bring back to us, we have a right nevertheless to insist upon something like reciprocation. Take Spain as an example. Whether we should have any dealings with that country is a question that will continue to be argued. But there is no question, whatever, that Spain is one of the world's best sources of mercury, one of the strategic minerals, and has abundances of many other valuable ores. If we do loan money to Spain, certainly it seems that we should receive from her, as payments against the loan, shipments of mercury and other minerals.

Each mineral must be stored with the resolve that its stockpile will never be broken into until a major war has actually come. Unless this is done, reserve storage will become the cause of instability in the metal markets, and the whole value of the stockpile will be lost. For example, if thousands of tons of copper are bought and placed in war reserve storage when black clouds of war are threatening, only to be sold back into the markets when the sun breaks through the clouds and the "peace of a thousand years" appears to have come, the dumping of the copper could ruin the copper industry. With any other metal it would be the same.

9

PERPETUAL HOMESTEADS

Besides expanding the areas of the cities, much dispersion of population can be effected by making it possible for several million of our people who prefer rural life to urban to move from the cities onto farms and ranches. This can be done by our Congress putting into use an improved homestead system of acquiring land, which is the subject of this chapter—homesteads not alone for farmers and stockmen, as in the past, but also homesteads of smaller acreage for gardeners and orchardists.

Any proposed method that will aid in atomic defense is of course doubly worthy of support if it will at the same time benefit the nation in other ways. The perpetual homestead is an example. A law putting it into force not only would help in reducing the population densities of the cities but also would bring about a more healthy division between rural and urban populations than now exists in most of the states. Moreover, in course of time such a law should almost completely eliminate the damnable share-crop system of holding land—a system that means poverty and a low social scale wherever it is in general practice—and replace it with a system of small

proprietors, which system wherever used means a high sense of freedom and individual liberty.

The owner of a farm of a size which he and his family ordinarily can till without hiring others to do a major part of the work, or without leasing a part of the land to a share-cropper, belongs in the class of small proprietors, and it is among this class that the principal improvers are found. So at least said Adam Smith, the greatest of economists, who gave incisive facts to support all his conclusions. But if a man's portion of the earth is extremely large it seldom happens that he is a great improver. So again said Adam Smith. The large proprietor not only is seldom an improver himself but by his dominion over a number of tenants he sustains feudalism. He is likely to make of himself something of a petty tyrant within his land domain and to make peasants in spirit and outlook of the tenants beneath him. In early America, in the main, it was the owners of the large plantations who were responsible for the growth of slavery. If the matter had been left to the decision of the plantation nobility it is not improbable that the business of buying and selling human lives still would be in practice in this country.

Thomas Jefferson, probably even more clearly than had Adam Smith, saw the small landowner as the most precious portion of the state. The political philosophy of this remarkable man was deeply rooted in the conviction that personal independence and democracy reside in small land proprietors more than in any other class. In the early years of our nation he advocated a division of its public lands among its citizens, limiting purchase to those already in

possession of little or no land, and setting a top limit to the number of acres any one man might purchase. This idea on land Jefferson carried with him to the presidency.

In the office of president, and after he had started the United States on the way to territorial expansion by purchasing from Napoleon the Territory of Louisiana, extending from the Gulf of Mexico to the Pacific Ocean, Jefferson's hope was that this immense domain, the largest piece of real estate ever to be transferred from one nation to another through outright purchase, might eventually become settled with small proprietors. The leaders of the Lewis and Clark expedition sent by him to explore the great area across its northern breadth were instructed to bring back to him in Washington samples of soil and species of plants collected along the way, and to report on the conditions of climate. Those who understand Jefferson's philosophy on land do not wonder that he seemed to find more pleasure in thinking of the new land becoming filled with homes of actual settlers than he did from speculating on the fact that the area, by reason of its enormous extent, gave the United States a place among the great nations.

The Homestead Act, passed by Congress just prior to the Civil War, was an act designed for apportioning the public lands among actual settlers. Framed in particular for the settlement of the public lands of the West, it called for selected areas to be surveyed into townships, each a rectangle of six miles square. The township was then divided into thirty-six sections, each section exactly a square mile in area. Then the section was quartered into

four equal squares, or quarter-sections. The quarter-section contained 160 acres, and was the amount of land that was allowed to one person as his homestead right.

Land offices were established on the public lands, under which worked an army of surveyors required to get the land sub-divided into quarter-section claims, and in the West for many years the surveyor and his transit were familiar figures on the skyline. After a considerable area in a region had been surveyed and plotted through the land office it was thrown open to settlement, and the land office served as the place of record and administrative control until a particular claim had been proved up. When this was done, the administrative control passed over to the state or territory, and the county clerk became custodian of the title record. It was then known as patented land, and the right of the state and county to assess taxes upon it followed as a matter of course.

The history of the Old West covers three distinct eras. First there was the fur era, during which Britain and France, and later the United States, which replaced France, competed fiercely for the rich harvest of peltry of the forest and streams of the Northwest, the territorial claims of the rival nations broadly overlapping one another. In no long time all the prized fur-bearing animals were all but extinct. Then the fur companies abandoned the area, and the log stockades and warehouses they had erected fell into ruin.

With the discovery of gold in California in 1848 came the gold era. Into California poured people from all corners of the world, all in wild hope of sluicing their for-

tunes from the gold-bearing gravel beds. When every foot of the gold region of California had been staked and prospected, the feverish miners by the thousands started spreading into other regions. Soon every stream in the West was being searched with the gold pan as thoroughly as it had been searched forty years earlier with the steel trap. But like the fur era, the gold era, too, was soon to pass, with the last deposits of placer gold washed from the sands and gravel of the stream beds, and the mining towns that had sprung up like mushrooms on their way to becoming ghost towns.

The short, feverish gold era was followed by the homestead era, which the Homestead Act had brought about. Out of the States came the land seekers. For years their trains of covered wagons crossing the grass-sodded plains appeared clouds of dust by day and rings of blinking campfires by night. Of the three distinct eras of the West —fur, gold and homestead—the last was the only one to live and bring to the West stable settlement and enduring prosperity. Indeed, the rapid and stable colonization of the West that took place under the Homestead Act was in many respects the greatest event of peaceful progress that history records.

The two decades from 1870 to 1890 were the greatest years of expansion in the West. In those twenty years, thanks to the Homestead Act, the population of the land now comprising the two Dakotas, Colorado, Wyoming, Montana, Idaho, Washington and Oregon increased ninefold. By 1890, in fact, so rapidly had grown the West that almost every important city of the present West had been

founded, and had its railroad station, schools, churches, stores, flour mill perhaps, and its three-storied Odd Fellows Hall.

The first of these two stirring decades was still within the era of the covered wagon and stage coach, although the first railroad to reach the Pacific had been completed in 1869. During the next decade the railroads spread hither and yon over the West in the greatest epoch of railroad building the world has ever known. In fact, before the end of that second decade more than half of all the railroad mileage ever built in the West had been completed. The covered wagon had had its day, and was only a wagon on the farm, and the stage coach was a relic, falling apart in the sun in the backyard of some livery stable.

After the best of the farming lands had been settled under the original Homestead Act, various other acts were brought into being for the settlement of other kinds of lands. Thus there came about the desert claim, the timber claim, the grazing claim and others. Eventually, in order to reclaim certain desert lands with irrigation, acts were passed allowing companies to capitalize for the purpose of building irrigation dams and canals, and authorizing the selling of water rights to the settlers on the new tracts opened for irrigation.

The free land grew more and more scarce, naturally, and as each new region was surveyed and thrown open, or an Indian reservation purchased from a tribe was surveyed and opened to white settlers, there was a rush upon the land office. Finally, because the number seeking land exceeded the available number of claims, the question of

priority had to be settled by drawing, or by some other method of chance. When parts of the Colville reservation in Washington, the Nez Perce reservation in Idaho, and the Missoula reservation in Montana were opened, the railroad had to run special trains to the places of drawing, and the number of registrants at each place was more than ten times the number of available quarter-sections.

Famous among the land rushes was the Oklahoma opening of 1889. There a large tract had been purchased from the Creeks and Seminoles, to be opened for settlement by white people. Instead of holding a drawing for places, or handling the matter in some other reasonable manner, the government chose to make a horse race out of it. At the border on the day of the opening waited twenty thousand people, some mounted on fast horses, some in surreys drawn by spans of flash trotters, and thousands who could not afford to put race stock into the contest mounted on ordinary cayuses or driving in hacks and light wagons pulled by horses taken from the plow. These twenty thousand waiting at the border were armed with an assortment of pistols, rifles, and shotguns, to give the aggregation an appearance described as more like that of an army of the homeguards turned out to repel a band of Comanches on the warpath than it did a group of land-hungry people seeking homesteads.

At high noon on April the twenty-second the signal to start was given, and the race literally was on in a cloud of dust. In the stampede that followed horses went down, vehicles were upset, limbs and shoulder bones broken, and dozens of other mishaps met with. Within a few hours

of the start the men mounted on race horses and those flying across the hills of prairie grass in buggies pulled by fleet trotters began arriving at the area of the homesteads. Luckiest of all, though, were a number of men who the night before had sneaked under cover of darkness inside the excluded area, hidden in the bushes, and already had their claims staked and their Winchesters ready to defend them before even the fastest of the horse gallopers arrived. Because the men who hid in the bushes got to their claims *sooner* than others, they became known as the "Sooners," and the name has stuck as a nickname for all Oklahomans to this day.

It was the vision of the planners of the original homestead act that once the public land of the West had been apportioned among actual settlers it would remain throughout the centuries a land covered with fruitful farms, none so small as to deny its owner a reasonably comfortable living for himself and family, and yet none so large as to create in America a system of land tenantry. This was a revival of Jefferson's ideas about land. But unfortunately it was not in the course of history for the West to keep itself rooted in the fundamental land policy with which it got started. Once a piece of land had been proved up and title to it obtained the land became eligible for a mortgage, and it was not long before most of the original farms had gotten these deadly pieces of paper hung upon them. When hard times came, beginning with the Panic of 1893, during the second administration of Grover Cleveland, mortgage holders took many of the farms. The original owners who survived were those who

were a little better than their neighbors at managing their farms, or whose luck was a little better. Some of these were not only able to hold down their own pieces of land, but were able also to enlarge their holdings by buying land from the neighbors who were going broke. But far more often it was not the few farmers who had fared well, but rather the bankers and storekeepers in the city who held the mortgages of the farmers out of luck, and succeeded to their hard-earned property. These gentlemen of the city seldom were farmers by instinct. Typically, when one of them acquired a new piece of land through a mortgage foreclosure, he rented it out to a tenant to farm for him on a share-crop basis, and he himself only drove out to the farm once or twice a year in his red-wheeled buggy behind a high-stepping span of Hamiltonians to have a look at how things were going. Thus in spite of all early hopes and intentions that the ownership of farms would preserve individual freedom, a tenant system of farming, with the owner living in the city and a sharecropper living on the land, gradually became an established way in the West, as it had already done in the South and to a less extent in the East—a system which, wherever it comes into practice, degrades the occupation of farming with poverty, backwardness and peasantry.

For a homesteader to lose his homestead by mortgage foreclosure, after he had spent years improving it, and had gone through all the hardships and deprivations of the homestead life, was a tragedy of failure and defeat the sorrow of which no one who has not seen a case of it with his own eyes can fully understand. Usually the home-

steader was a man who had come West with his wife and children to find his freedom in land. He had become attached to his quarter-section, and farming for him was the only occupation he knew about or about which he really cared. For him, consequently, the day the sheriff came out from the city with a mortgage foreclosure in his pocket and served it upon him was the end of his world. He could take down his rifle and shoot the sheriff even though he was only performing his duty, and was not one of the persons who had wronged him. He could go into the barn and hang himself to a rafter with a halter rope. Or he could pile stoves, beds, chairs, and his family into a wagon and drive off to the city, there to search for any kind of work his strong but unskilled hands might find. The last, of course, is what the farmer who had gone flat broke did do—drive off to the city with his family. But his shoulders were bowed, and for him all of hope and glory had gone out of his life.

In many a rural region, as its farms grew larger and larger, coming under the ownership of the few unusually successful farmers, or, more numerous than they, the mortgage holders who lived in the city, school districts were broken up, two districts or even three being consolidated into one, for there were no longer enough school children to fill all the schoolhouses that had been built back in the days when the region was a thriving community of homesteaders. It is a sorry fact that by the year 1905, in many places in the West it was more difficult for a boy or girl living in the country to get a grammar school education than it had been back in the homestead days twenty years

earlier, when there had been a family living on every quarter-section of land.

No nation that has the best of its farming lands held by land overlords and farmed by share-croppers can expect to become and remain as prosperous, happy, and strong as a nation whose lands are mainly in the possession of small proprietors. That is what Adam Smith and Thomas Jefferson and other great economists had thought and said, and the subject is one to which they gave years of deep study. Looking back now upon the lamentable endings to which came a large number of homesteaders in the West, whose homes were lost by the mortgage foreclosure, it is seen how much better for the country as a whole it would have been had a man losing his homestead been permitted to travel into a newer region of the West, there to take up another homestead, and begin life anew upon it. But this he could not do. Having used his homestead right once, by the homestead act itself his right to further homesteading was barred.

It would have been even better, both for the individual and the nation if public lands once settled as homesteads must always be held, under the government, as homesteads owned by the homesteader occupant. Such method of possessing land is possible. In fact, there were many homesteaders who did choose of their own accord to hold their claims in this manner for many years beyond the required minimum time for making final proof upon them. On homesteads held in this manner the occupants enjoyed all profits from the land just the same as they would on patented land, and they were not required to pay any land

taxes to the state. If the option of continuing to hold a piece of land as a homestead or proving upon the land and obtaining title to it had not been given to the individual but, instead, all land had been apportioned under a system of perpetual homesteads, each quarter-section always would have retained its identity, and could never have become merged in ownership with another piece of land. Moreover, if the land had been handled in this way it never could have become mortgaged, to run the risk of being lost. If sold or relinquished in any other way, such relinquishment would have been at the owner's volition or by reason of his death, not by mortgage foreclosure, and the new owner would necessarily have been a person with a right to hold a homestead.

Because of the unfortunate endings to which most of the homestead farms and ranches did eventually come, it is not advocated that the federal government buy land and resell it to individuals, who will run the risk again of mortgage foreclosures, but, instead, it is recommended that a new set of homestead laws be enacted. Under this law the government would establish land offices throughout the country, and through these offices buy land wherever it can be found at reasonable prices, and resell it as perpetual homesteads to those holding homestead rights. A third of the cost of the land, or of the value of the buildings and other improvements upon it—whichever is the larger amount—would be required as a down payment, and the balance, plus a reasonable interest, would be paid over a period of ten years.

Each adult, both man and woman, would be entitled

to one renewable homestead right. This right could be used to hold possession of a homestead farm of 160 acres, a ranch of 320 acres, or a garden-orchard tract of 10 acres. Ownership of one homestead would bar ownership of another, except that in order to permit a man desiring a change in locations to buy a new homestead before disposing of his old one, or to permit him to come into possession of a second homestead through inheritance, a reasonable overlapping time, say six months, would be allowed him. Within this overlapping period he must dispose of either the old or the new homestead. If he should fail to comply with the law in this respect, it would become the duty of the land office to take possession of the new homestead and sell at public auction, and turn over the money received for it, less charges to cover the administrative expenses involved, to the owner. Probably a case requiring such action would be extremely rare.

The owner of a homestead, no matter what its class, desiring to sell his land would be free to name his price and bargain with prospective buyers just as he can at the present time with a piece of patented land. Or the land could be sold back to the government at a price offered by the land office, to be disposed of by the government as the law might require.

If the land is sold to an individual and the transaction is for cash, the transfer papers will be handled by the land office. But if the new owner seeks to buy on terms, the land office would determine whether it would be fair to require a third or more than a third as the down payment, with the understanding that the balance would

be divided over a period of ten years, with interest. In this case the new owner would owe the balance to the government, exactly the same as if this were the original sale by the government as a homestead. The seller would get the full amount of the selling price in any case, less any fixed administrative charge by the government, and of course less any unpaid balance the seller might owe the government at the time of making his sale. If the transaction is made through a real estate broker, he would have his fee. The part that the realtor would play in this homestead set-up is important, and will be more fully explained further along in this chapter.

Whatever the causes for the alarming decline of the rural population in most of the states during the past two decades most certainly a scarcity of farming land is not among them. Throughout the United States there are lying idle many millions of acres of land that could be growing crops and livestock, and giving homes to millions of people who love farming and have no skill or trade or professional qualifications that fit them for the city. One need only drive out the back way of the District of Columbia, across the Anacostia Bridge, and thence southward along the peninsula in Maryland to a region where some of the earliest colonial homes were built, to meet with terrain once covered with farms and farmhouses, and to all appearances good land still, but now overgrown with second growth pine and wild blackberry bramble, and the farmhouses that once dotted the landscape represented here and there by an old building given over, long since, to the woodrats and wasps, or an old chimney still stand-

ing where fire has destroyed a house, or a grove of shade trees that can be recognized as a site where a farmhouse once stood. There seems no good reason why this land might not be turned into good farms again, if a different system of land possession can ever be put into law to replace the present system of land holding by which the farming land of the nation steadily has become degraded. The same condition of neglected farms and the same factors accounting for it can be found in almost every other state.

The homestead act here recommended would provide that a homestead could never for any reason be taken away from an owner during his lifetime against his will. If the land is a farm, ranch, or a garden-orchard tract, purchased on terms, and the owner becomes delinquent in his payments, the government by a special provision of the act itself would be empowered to take over the property, all except the house and a garden space of defined area surrounding it, and rent the land at public auction on a long-term rental basis, crediting against the indebtedness the amount received, less a fixed administrative charge. When the amount due the government, either through the cash rentals received, or these amounts supplemented by any payments the owner may later be able to make, is fully paid, the government would allow the owner to come again into complete possession of the property at the expiration of the period of the lease. By such method of handling, the owner of a ranch, farm or garden-orchard tract, if delinquent on payments, would be deprived of the full possession and use of his land until such delinquency be-

comes extinguished. This, though it may have the appearance of harsh treatment in some instances, is much better than that the owner who cannot keep up his payments should lose his land completely through a mortgage foreclosure. Besides, he will have left for his home the house on the land and a garden plot around it during the time he is delinquent.

Probably there seldom would be a case in which the government would lose money on a homestead of any kind. If the owner should die before the land has been fully paid for, but was not delinquent in payments, the heir would simply take up the yearly payments where the original owner left off. But if the owner was delinquent in payments, it would be the obligation of the heir to eradicate the delinquency as a qualification for his coming into possession of the property. If the heir failed to do so, the government would cause the land to be sold at public auction, paying to the heir any amount left over from the sale after the government's accounts have been completely satisfied.

Another important feature of the proposed new homestead law is that the land could not be willed to several heirs in any way that would cause the land to be divided. The homestead act itself would require a system of tenure by which the land would always remain intact. Ways are open, and have been used in the past, by which property remains intact after the death of an owner. In England, for example, landed estates have been held intact in the same family for hundreds of years. This could be accomplished for homesteads by requiring the owner to file at

the land office the name of the heir to his homestead. Or the owner could specify at the land office that he desires the land to be sold by the government upon his death, and the net amount received to be divided among named heirs. These are only suggestions. The point is that many ways are available for the framers of the homestead act to devise a form of tenure which will prevent the physical division of a homestead.

Still another important feature of the proposed homestead act would be the exemption from property taxes, although the owner would pay income taxes on any revenue derived from the land, as he now must do. In case of a failure to pay an income tax to the United States, or any other indebtedness to the United States, the amount could be charged against the land, just like an installment payment. If after a specified period the indebtedness is not satisfied, the government could take the same action as for delinquency on the purchase payments. In case of an income tax due a state or any other indebtedness to a government inferior to the federal government, no possession of the property could be taken, because, in the final analysis, the land would be the property of the United States. This would be only another example of a conflict that has been steadily growing between state and federal governments over the right of each to tax the same piece of property or the same income. This conflict is not likely to be resolved until and unless the federal government will discontinue all sales taxes, internal revenue taxes and excise taxes, in order that the state governments may have the sales taxes as their principal source of

tax incomes rather than property taxes and state income taxes.

The philosophy of exempting homesteads from property taxes requires explanation. A farm is the farmer's tool for earning his income, which income is not, in the usual case, as much as a carpenter's or a brick mason's or even that of an unskilled laborer. On whatever income he does earn from his farm he pays income taxes, as all other people pay taxes upon their incomes. But in addition to that the farmer who owns patented land must pay to the county and state a real estate tax. This makes him the victim of double taxation, being required to pay both a tax on the tool by which his income is earned and on the income itself.

Many years ago, before the Sixteenth Amendment to the Constitution permitted the federal government to impose taxes on incomes, and we were much less an industrial nation than we have since become, a tax on land was a necessity. A land tax is still justifiable along with an income tax in the case of a large area of land owned by one person. Just as much as it is right that a corporation should be taxed by the state for its worth in buildings, grounds, machinery and other fixed property, and in addition to that required to pay the federal government a corporation tax on its earnings, so also is it right that the owner of a large farm should be taxed by the state on the valuation of the land, and by the federal government on the income from the land. But in case of a homesteader, whose land by its size presumably would be limited to a family income, a different principle is involved. To give

him a slug of taxation from both barrels would be no more right than that a carpenter be required to pay not only an income tax on his earnings, but also a tax of a hundred dollars or so on the hammer and saw by which these earnings are made, or that a trombone player have to pay a stiff yearly tax on the instrument by which his pay with an orchestra is earned.

Under the homestead system as it is here advocated, although tillable land would be classified as ranch, farm, or garden-orchard according to its potential productivity, there would be no restriction as to the kind of crop the owner could plant. The fact, for instance, that a piece of land was sold as a homestead of 320 acres instead of a farm of 160 acres, because deemed better suited for grazing than for cultivated crops, would not mean that the owner could not grow or try to grow cultivated crops upon it. It would mean simply that when the land is divided into ranches, farms, and garden-orchard areas, the land office would make an honest attempt to classify the land according to prospective availability. In each case the amount of land would be that deemed sufficient to earn for the owner and his family a decent living, if properly managed. If time should prove that a particular homestead was in the wrong classification, and should the land ever return to the possession of the government it would be within the province of the government to change its classification. Whether crop price support should be allowed on a crop grown on land outside its classification is a question that probably should not be answered until there

have been enough factual cases on which a considered decision can be based.

160 acres has been used here to designate the proper size of a farm and 320 acres for a ranch. These figures have been taken because in times past they have been used and, in general, found satisfactory in dividing land in the West among homesteads, using the smaller acreage for the farm lands and the larger one for land deemed suitable only for grazing purposes. But it is realized that much of the land throughout the nation, particularly in the original thirteen states, was not originally surveyed into farms of uniform size as was the land of the West, but the boundaries in many instances were determined by land marks. To try now to put such pieces of land into farms and ranches of exactly 160 acres and 320 acres, respectively, could not be accomplished without having left over a large number of odds and ends in every general area. For this reason, the figures 160 and 320 must be used only as guides. In some areas because a piece of land could not be cut exactly into a farm of 160 acres, it might have an acreage anywhere from 100 to 200 acres. Similarly, a ranch might have acreage from 200 to 400 acres. Also, a garden-orchard tract could not always be exactly 10 acres in area, but might contain a few acres more or less than the standard size.

Naturally, the owner of a homestead would not be restricted from owning patented land in addition to his homestead. In any given area, then, the two classes of land would be found. First, as now, there would be the pat-

ented and taxable land, and the office of the county clerk would have custody of its title record. But here and there throughout the region, wherever the homestead seekers might find pieces of land, the price of which the land office considers fair, would be the farms and ranches purchased through government financing and held as homesteads, and the land office located somewhere in the general region would be the custodian of the papers. It could be hoped and expected, though, that eventually the homestead land would increase in acreage over the patented land, because it would be to the advantage of the small proprietor to own a homestead farm rather than a farm of patented land, and it is the small proprietor most of all that the government should be interested in getting into possession of the soil. But during the time the two classes are in existence side by side in any area, there would be nothing by which the eye could distinguish the one from the other, except that the homestead, because it would be a bona fide home, probably would have about it more of an improved appearance than a piece of land farmed by a share-cropper. The owner of the perpetual homestead would have every right in his land that the owner of a piece of patented land would have, including the right to sell or trade it. Besides, he would have freedom from land taxes, and the assurance that the farm could never against his will be taken away from him.

The purpose is not to make country people a pampered class, nor to devise any magically easy way in which to come into possession of a homestead. The man who seeks to buy one through government financing must be able to

make a cash down payment of a third of the purchase price, and that might not be easy for him to do. He might have to put aside a part of his earnings for several years, and deny himself and his family many things, in order to be able to make this required down payment. But this does mean that once a man has come into possession of a homestead of his choice, the land during his lifetime can never be taken away from him against his will. For him a piece of land once acquired would be a rock of refuge for the remainder of his life.

Because the homestead under the new homestead act would be purchased land, there would not be any requirement, of course, that the owner must live upon it in order to hold it, as was the case of the old homestead, which was won by settling upon it for a required period rather than through purchase. There would be an advantage in this change. It would make it possible for a worker in a factory, a business man, or any other person whose employment or trade is in the city to acquire the farm upon which he would like to live when he retires, without waiting until his retirement has become a fact. In the meantime, if the land is too distant from his place of employment to permit his living upon it, he should be able to rent the land to the owner of a neighboring piece of land, and, if the farm was not overpriced when he bought it, the rent should provide the annual payments to the land office.

But if the land is within convenient daily driving distance from his place of employment, he can, if he wishes, live on it with his family and avail himself or hired agricultural machinery service to do his own farming. This

hired machinery service has only recently become available, but it is rapidly growing in popularity throughout many sections of the country, because the farmers using it are put to less expense and risks for plowing, harrowing, sowing and harvesting crops, than they are when owning the expensive machinery for the jobs and doing the work themselves. For many men living on a farm before retirement, however, a more interesting arrangement would be to keep the land planted in grasses for grazing and haying, and raise beef cattle for the market. If a man is at heart a livestock man, he can spend his week ends and vacations with branding, dipping, mending fences, putting up hay for winter feed, dickering with cattle buyers, or, if nothing else to do, with just sitting on a fence watching cows eat grass, and never grow tired of the life.

The proposed act creating the perpetual homestead would not allow any method of government financing for home building. Neither could a contractor build a home on the property, to be secured by a mortgage on the property and paid for in installments over a period of years, because a feature of the homestead would be that it could not be mortgaged. This restriction is mentioned here as a blessing and not as a shortcoming. The owner of a house, if required to pay in full for the material and labor to build it, would not be likely to overstrain his finances on buildings, as so many have been doing this past decade—a practice which has been largely responsible for the rise in prices on all homes. The homestead house need not be pretentious. A rustic house, warm and com-

fortable, but not costing much will do in the country, whereas in the city the same house might seem too humble.

If the homesteader must have a financed home, however, he could purchase a removable, pre-fabricated house, which can be sold to him on installments the same as an automobile, with a mortgage upon the house itself, not upon the ground on which it sits. There are already on the market pre-fabricated houses of this kind. They are not the best houses in the world, but they can be roomy, clean, warm and comfortable.

Earlier in this chapter it was said that the owner would have the same right to sell a homestead as he now has to sell any piece of patented land he may own. The only difference is that the buyer must be a person at the moment of the purchase who has a right to purchase a homestead, and the transaction would be handled through the regional land office. But distinctly the land office would not become a real estate office, no more than does the county clerk's office at the present time function as a real estate office.

The real estate broker, consequently, would not be ruled out by a homestead system of holding land. On the contrary, his office would become an important part of the system. To it normally would come those in search of rural homes, as only here could specific information be readily obtainable on farms, ranches and garden-orchard property in particular localities, and general information on climate and other pertinent matters. The real estate agent, who would be a qualified and registered realtor, would handle the transaction between buyer and

seller, and would have his fee, which would be a fixed fee graded to the purchase price of the property, and would be collected in full at the land office from the money paid down by the buyer, and turned over to him.

Also it was earlier said that at the start of the new homestead system the government, through its regional land offices, would buy land wherever bargains can be found and resell it as farms, ranches, and garden-orchard ranchitas. This method, however, probably would seldom be used except in cases of large estates, where several hundred acres could be purchased in one deal, to be divided into several homesteads. In most other cases, an owner wishing to sell a piece of land that presumably could qualify for a homestead, and for which he could, when the time comes, be able to furnish a guaranteed title, would list his property with a realtor. Then the regional land office would be contacted by the realtor. If the maximum price to be asked for the land and other factors involved are acceptable to the superintendent of the regional land office, the land would be offered for sale by the realtor for his client. A buyer for it found, the transaction would be completed through the land office, by which the title to the land would pass to the government, and in the same transaction be turned over to the buyer as a perpetual homestead. The realtor's fee would be collected by the government at the time of the sale and turned over to him.

10

AN INDESTRUCTIBLE CAPITAL CITY

A WORD picture that has been painted often enough since the atomic bomb first became a threat against our own country shows Washington completely and suddenly destroyed in an attack. The President, Vice-President, the Cabinet and all members of Congress present in Washington at the time of the attack are among the thousands of dead. In one blinding flash federal government passes out of existence, and there is no constitutional machinery by which it could immediately be restored.

The presumption by some is that in such event trust would have to be placed in the legislatures of the several states and committees of citizens to set up a new national capital at some other place, cloak it with national authority, and get it functioning somehow. To others the situation would seem to call for a military leader stepping forth and proclaiming military government as the law of the prostrate nation, and himself as the head of it. In which case, under his declared dictatorial authority the nation, it would be hoped, could be successfully led through the war and, after that, the military hero would modestly re-

fuse the crown that screaming thousands would be trying to slap on his head, and restore elective authority to the people. Horrifying as this picture of a destroyed Washington is, it is scarcely overdrawn.

Our federal government has in course of time grown more and more complex in its functions, like the evolution of the human body, until today Washington, the capital city, is to the nation what a handful of gray matter in his skull is to the body of a man. This was not always so. At the time of our Revolutionary War, for instance, if the lack of a highly centralized authority was a shortcoming when it came to trying to organize a great concerted offensive action against the British, at other times it was the salvation of the cause of independence that there was nowhere a nerve center at which the foe could strike and thereby paralyze the whole of the confederated colonies.

In the War of 1812 we were still so loosely knit as states that when, in 1814, the British captured and burnt the city of Washington, its fall had no serious effect, one way or the other, on the course of the war. During the period 1861–1865, when the Civil War was on, our country was still a nation whose strength was segmented among its several states. The armies that comprised its forces, except for a few regiments of the Regular Army that had been needed to protect the frontiers against the Indians, were state troops.

Indeed, so much had the strength of the nation always been partitioned among its several states, that when eleven of these states withdrew from the Union in 1861 and set

up their own government, so little machinery of federal government was required to bind them together and start them functioning as a new nation that they were almost successful in making their secession from the Union permanent. Among the states that remained in the Union, too, because of the same segmented strength, there was no single spot among them highly critical to the whole.

Time and gain the North's capital at Washington was threatened with capture. Even when the war seemed to be nearing its close a Confederate battery of field artillery succeeded in getting inside the city, unlimbered at a spot near where now stands Walter Reed Hospital, and from its positions plopped cannon balls upon Pennsylvania Avenue. On that day, as on other excited days, the government was prepared to start moving, bag and baggage, upon a moment's notice, if ever the order became necessary, but by a fraction it never was. Had the capital been forced to move from Washington, the outcome of the Civil War could hardly have been different from what it was. The North put down the South in the end, not because it was able to save its capital from capture, but because its manufacturing facilities for the replacement of cannon, rifles and ammunition, and its facilities for transportation were better than those of the South, and because it was strong enough at sea to blockade the ports of the South.

Between the time of the Civil War and the present day there has been a great change in the functioning of our government, one by which the national capital has become a unique spot whose indestructibility is absolutely essen-

tial to the life of the nation as a whole. It is necessary to understand the reason for this great change. Persons who do not understand it are in danger of being led into a false sense of security by imagining that our capital could again be destroyed by the enemy in time of war, as it was in 1814, without fatal injury to the national government.

February 15, 1913, though seldom mentioned as a memorable date, actually is a point of time marking the greatest change in the government of the United States that has ever been made during its long history. It was on February 15, 1913, that the Secretary of State declared by proclamation that the Sixteenth Amendment to the Constitution had been ratified. The Sixteenth Amendment gave Congress "power to lay and collect taxes on incomes, from whatever sources derived, without apportionment among the several states." In 1916, under authority of the Sixteenth Amendment the Federal Income Tax Law was passed. Ever since that year, and as a result of the working of this law, our nation has continued to grow more and more centralized in its power, in proportion to the increase in the rates of income taxes, and the state governments, correspondingly, have continued to wither into less significance.

At first the change-over from a nation with its strength segmented among its several states to a nation of centralized strength was not easily noticeable, because the rates of the original income tax law were not excessive. Now it is a different story, as every man and woman in the land who has an annual income exceeding $600 knows. The Federal Income Tax Law in its present form, which

can tax above seventy-five per cent on the upper brackets of individual earnings, has drawn into the federal government an immensity of power it never had before. Indeed, the Income Tax Law has made our nation probably the most centralized nation in the world.

Here is not the place to question the right of the federal government to reap with its big income tax scythe an almost unlimited share of the earnings of the citizens, leaving to the states only the gleanings, and pinching the states until they must come begging at the door of the national treasury for social security, unemployment relief, highway construction, and funds for dozens of other local activites which, in former times, properly were the sole province of the state, county and local governments. Nor is it here the place to discuss any proposed way by which overcentralization of federal government might be done away with, and a form of government with its strength segmented among its several states restored to the country. The fact to be emphasized here is that our national capital at Washington is a different organ today than it was during either the War of 1812 or the Civil War. It is now such a highly centralized nerve center that if ever destroyed the whole body of the nation will become instantly paralyzed.

We can be certain that no one knows better than does our potential enemy, who has made it his scientific duty to prod and explore us for all our spots of greatest vulnerability, how difficult it would be for us to resist an invasion, to say nothing of trying to mobilize, train and equip an army of five million to send overseas, if on the

very first day of the war all of the elected and appointed federal officials, together with the thousands of civil service employees and all the records and machinery by which the entire office of federal government is administered, are buried under mounds of smoking ruins in Washington. This initial blow would be a bullet through the national brain. Given a stockpile of 2000 atomic bombs with which to start the war, the enemy could afford to send the entire number against Washington all at once, if he might be sure that at least one bomb in the batch would find the target, for it would require only one scored atomic explosion over Washington to put our federal government virtually out of existence.

Of course it would be ridiculous to imagine that the enemy might have to think about spending his entire stockpile of bombs in trying to place one good hit on Washington. No ring of antiaircraft guns or police of planes could be depended upon to bring down every approaching enemy plane bearing an atomic bomb. Indeed, it has been estimated by persons highest in authority on the subject that seven out of every ten enemy bombers could get past our air defenses. And besides bombers there would be available to the enemy rockets launched from submarines surfacing off the coast of Delaware or from the decks of his commercial ships in waters off our shores.

But with all the warnings on how easily the national capital at Washington could be destroyed that recently have come from many responsible persons, including many members of Congress and officers in high rank among the armed forces, the warnings so far have produced almost

no feasible actions or even suggestions for defending our nation from a disaster so staggering. The whole ghastly matter has seemed like one of those disgusting murder dramas in which a household has been thoroughly warned that there is going to be murder by the clock, but not a person of the group seems to have enough sense or the courage to move to another place or arm himself with a weapon. All just sit in a huddle at the center of the room as helpless and horror-struck as so many cornered sheep, waiting for the murderer to come and carry out his threat.

It is not exactly true to say that there have been no suggestions whatever to meet the threat of a destroyed Washington. Recently some proposals have been made for building at a short distance from the capital some auxiliary buildings into which, when war becomes imminent, some of the operating personnel and the records of the several departments of government could be moved. But it is obvious that the enemy hardly could be kept completely in the dark about the locations of these auxiliary buildings, and if he thinks the destruction of them important enough, certainly should be able to destroy them as easily as he can destroy the capital itself. The trouble with an idea of this kind is that, if ever put into effect, the false sense of security it will give and the funds it will use up could preclude a solution really capable of saving the nation's capital from being destroyed.

What the nation needs is a new capital city, one in which, when war becomes imminent, the President, Vice-President, members of Congress, the Judiciary and the heads of the several departments of government and their

staffs will be able to live and work without the constant fear that at any moment they may be blasted into eternity. Moreover, the nation needs a capital city which, when war does come, can be expected to stand and function as the capital as long as there is left any corner of the United States to serve. This last can never be expected of present Washington, one of the most vulnerable spots in all the United States.

No nation that expects to live and preserve its place among the strong nations of the world can consider the retention of the present site of its national capital, for historical or sentimental reasons, or by reason of present investments in buildings, grounds and facilities, to be of greater importance than the preservation of the nation as a whole. After all, the purpose of a capital is to serve its nation, and it is not the nation that should be sacrificed to save the capital. France in 1941 is a warning example. In strength France's fleet was in Europe second only to the fleet of her ally, Great Britain, and her army was strong in numbers and equipment. Though beaten in the field by the greater might of the German machine, France could have moved her army and its equipment to North Africa and from that segment of her empire as her provisional base, and with her navy to prevent the Germans from pursuing across the Mediterranean, might have persevered as a nation while the war was being decided by events elsewhere. But as the German armored columns approached *La Belle Paris*, the threatened destruction of the city was more than the weak heart of the French government could bear. The government chose to sacrifice

the nation instead. By the surrender Paris was saved, but France, the nation that had lived magnificently in glory and courage through so many centuries, lost in that one evil hour of surrender something it may never be able to regain.

Our own capital has no claim upon the heart of the nation that should cause one tear to be shed if it must be moved to another location. It covers no battlefield or other spot of sanctified soil. It stands on ground the general location of which was agreed upon in a horse trade between the leaders of the two major political parties of the day. The selection of the exact site was left to a board of three persons, who went out to look for it in much the same way as might a board of army officers set out to look for a location for a new cantonment.

And in its history since that time the city has won no laurels for itself. On the contrary, during the war of 1812 it was disgracefully abandoned with scarcely a shot fired in its defense. A fortress located just outside the city, which had been planned by the brilliant French engineer Major L'Enfant, planner of the city itself, whose solid, unscalable walls might have withstood all the infantry and artillery thrown against them, was given up to the enemy in as cowardly a fashion as the city itself. This great piece of masonry, which was built at heavy expense for its day, complete with drawbridge, moat, massive-walled magazines for the storage of ammunition and provisions, and well sunk below the bed of the Potomac for its supply of water, has been treated by time and the elements better than it has deserved, and today it can be

seen by those who go to look for it probably not greatly changed in exterior appearance from what it was on the day it was turned over to the army by its builders a century and a half ago. Yet today there are thousands of persons who have lived in Washington all of their lives who have not used an hour of their time to visit this great fortress, and it is never listed nor mentioned as one of the capital's sights, such a disgraceful blot was its spineless surrender upon the nation's escutcheon.

In further argument on this point about the location of the capital it can be said that back in the days when the capital had to be moved from one place to another for any urgent reason, the government did not hesitate for a moment to move it. In all, the nation's capital occupied seven different cities before it came to rest where it now stands.

It is true that when the present site was selected for Washington in 1800, the location was a convenient one, all things considered, to the population comprising the sixteen states which at that time made up the nation. But the expansion of the nation westward since that time, beginning with the Louisiana Purchase, has left Washington sitting upon a flank of the nation.

After minds have been made up that the national capital must be moved completely from its present woefully defenseless location, a decision must be made as to where it will be relocated.

If terrain alone ruled for the new site of the capital, California, Oregon, or Washington could offer many spots in their rugged, beautiful mountains. But any location on

the Pacific Coast would again be putting the capital upon a flank of the nation. Also, in case of invasion from the direction of the Pacific Ocean a capital along that side of the continent would be within the territory first to fall to the enemy. In the Virginias, the Carolinas and Tennessee, there are many spots of excellent mountain terrain, but for reasons similar to those for the Pacific Coast, a location for the new capital should not be selected from among them. Further inland, in the region of Sun Valley, Idaho, the area of the Tetons in Wyoming, and the northeast corner of Utah, there are areas of rugged terrain, yet accessible by train and the other means of transportation, but too far to the west to serve the nation as a whole with the greatest convenience. If a central location combined with ruggedness of terrain and accessibility were the only deciding factors, Arkansas could offer her beautiful Ozark Mountains. A disqualifying feature about the Ozarks, however, would be their openness to an attack from the south, and the terrain, although rugged, cannot in this respect match the terrain of many other regions.

If the approximate geographical center of the United States is determined by the intersection of two lines, one drawn from the tip of Florida diagonally across the United States to Cape Flattery in Washington State, and the other line drawn from the tip of Maine to the southwest corner of California just below San Diego, the center will be found to be only a short distance from the place where the continental divide extends farthest east. Here is located the Rocky Mountain National Park, and it is the area within and about this park that seems to have a better

claim than any other place as the new capital of the United States. Within an area comprising the park, the Roosevelt National Forest adjoining it, and open land lying to the east that could be purchased by the government, could be located a capital city with terrain to give it the maximum protection that terrain can give. Yet the area would be approachable by rail, highway and air, and it would be centrally located with respect to the whole of the United States.

The site for the new capital city having been selected here, care would be taken to give much greater space to it than now is contained in the District of Columbia, so that the various bureaus and agencies of the several departments of government might be segregated into separate buildings and the whole widely dispersed. Into the solid rock of the buttes and ridges that abound about the area would be tunneled caverns for the storage of permanent records, and chambers where personnel could work and hold assembly during times of great peril, safe against the most powerful atomic bomb that might be projected into the area. Care also would be taken that within the area of the capital proper only buildings strictly pertaining to the government would be placed. The commercial city to serve the capital would be spread over a wide semicircular area about the eastern side of the capital area. Here would be space for the homes of the officials of the government, the thousands of civil service employees, hotels, railroad stations, bus terminals, air fields, and all the other establishments presently connected with the capital city. With proper zoning for this commercial city,

like any other city achieving atomic defense through dispersion, it would never be allowed to exceed a certain population density.

It is true that the Constitution authorizes for the national capital an area not exceeding ten miles square, but this provision would not prevent the government from putting additional land into the capital area, as already it has done about the present Washington. Later, if deemed necessary or desirable to have all of the enormous capital area, including the commercial city to serve it, to come under the unique rule of the Congress, an amendment to the Constitution could authorize this. But if the people to occupy the commercial city have any choice in the matter they would probably ask that this area be left as a part of the state, in order that its residents may have the right to vote and to rule their own city the same as the citizens of any other community.

If the purpose here were the promotion of real estate or tourist trade, it would be interesting to tell how Washington, moved to the Rocky Mountain National Park region, certainly would have the most beautiful and inspiring location of any capital city in the world. In variety of features and beauty there is not another spot in the world to outrival it. From the area you drive in an easterly direction and in less than an hour you are in a semi-arid land, where grow the short buffalo grass and sage bush, and the chirp of the prairie dog is heard, and jack rabbits bound across the road ahead of you. Here on the low hills are grazing sheep and white-faced cattle, and the valleys, wherever irrigation water can be brought to them,

are green with fields of sugar beets and alfalfa. Gorgeous golden pheasants stand at the roadside as you pass, seemingly as tame as domestic fowls. Further on, you meet with fields of winter wheat and barley. You are in Colorado still, but it is not the kind of terrain that mention of the name of Colorado connotes; rather it is an extension of the great plains of west Kansas. You are already back East, it seems; before you the highway, with not another hill to climb, leads to Kansas City, Chicago, Cleveland.

But in the Park area, if you travel west you are soon inside an immense upland valley walled about with mountain chains. All about you are dense forests, alpine meadows, crystal streams tumbling among great boulders, and glacier lakes clinging to the sides of the mountains. Above you, in the realm of the clouds, glisten peaks of everlasting snow. Altogether the scene is like a grouping of scenery painted on an enormous spread of canvas for the backdrop of a stage.

Moreover, this incomparable land offers what only a few regions of the West can offer, well-defined variety among the four seasons of the year, rivaling the charm of New England in this respect. Whichever season you start with is beautiful, and each successive season seems to try to surpass the last. In the winter the ground is covered with snow crystals, glistening in the sun, but so dry is the atmosphere and so cloudless the skies on a typical day that a face can tan as quickly as on a Florida beach. Then comes spring and the soft, warm chinook winds awaken life in the earth. Canyons gush and roar. Wild flowers in rare profusion of bloom and fragrance tapestry the moist hill-

sides. Then comes summer and the great air-conditioned basin is neither hot nor cold, just as near perfection in weather as any place will ever have. Hay fever is practically unknown. Then comes the first frost of autumn, and in a day the leaves of the aspen tree are turned to purest gold. Through the extended Indian summer, the interspersed groves of aspen, firs, spruce, and pine along the mountain slopes are a symphony of gold and green. Below is a kodachrome of blue and white tumbling streams and banks flaming with scarlet leaves like a forest afire.

It does seem strange and very wonderful that of the many spots of rugged terrain combined with accessibility to transportation that deserve to be discussed and considered as the new location for the capital of the United States, the one of these that stands nearest the heart point of the nation, which is the Rocky Mountain National Park in Colorado, should also be chosen by many of those who have seen it as the most beautiful spot of nature in all the world.

APPENDIX

All cities reported by the 1950 Federal Census to have a population of 15,000 or more are shown in this table, and also the pro rata shares these cities would receive from a Federal appropriation of 15 billion dollars for civilian atomic defense, such as is recommended in Chapter 4 of this book.

	Population 1950	Pro rata share
ALABAMA		
Anniston	31,066	$ 6,834,520
Bessemer	28,445	6,257,900
Birmingham	326,037	71,728,140
Decatur	19,974	4,394,280
Dothan	21,584	4,748,480
Florence	23,879	5,253,380
Gadsden	55,725	12,259,500
Huntsville	16,437	3,616,140
Mobile	129,009	28,381,980
Montgomery	106,525	23,435,500
Phenix City	23,305	5,127,100
Prichard	19,014	4,183,080
Selma	22,840	5,024,800
Tuscaloosa	46,396	10,207,120
ARIZONA		
Mesa	16,790	3,693,800
Phoenix	106,818	23,499,960
Tucson	45,454	9,999,880
ARKANSAS		
Blytheville	16,234	3,571,480
El Dorado	23,076	5,076,720
Fayetteville	17,071	3,755,620
Fort Smith	47,942	10,547,240
Hot Springs	29,307	6,447,540
Jonesboro	16,310	3,588,200

	Population 1950	Pro rata share
Little Rock	102,213	$ 22,486,860
North Little Rock	44,097	9,701,340
Pine Bluff	37,162	8,175,640
Texarkana	15,875	3,492,500
CALIFORNIA		
Alameda	64,430	14,174,600
Albany	17,590	3,869,800
Alhambra	51,359	11,298,980
Arcadia	23,066	5,074,520
Bakersfield	34,784	7,652,480
Bell	15,430	3,394,600
Berkeley	113,805	25,037,100
Beverly Hills	29,032	6,387,040
Burbank	78,577	17,286,940
Burlingame	19,886	4,374,920
Chula Vista	15,927	3,503,940
Compton	47,991	10,558,020
Culver City	19,720	4,338,400
Daly City	15,191	3,342,020
El Cerrito	18,011	3,962,420
Eureka	23,058	5,072,760
Fresno	91,669	20,167,180
Glendale	95,702	21,054,440
Hawthorne	16,316	3,589,520
Huntington Park	29,450	6,479,000
Inglewood	46,185	10,160,700
Long Beach	250,767	55,168,740
Los Angeles	1,970,358	433,478,760
Lynwood	25,823	5,681,060
Manhattan Beach	17,330	3,812,600
Merced	15,278	3,361,160
Modesto	17,389	3,825,580
Monrovia	20,186	4,440,920
Montebello	21,735	4,781,700
Monterey	16,205	3,565,100
Monterey Park	20,395	4,486,900
National City	21,199	4,663,780

	Population 1950	Pro rata share
CALIFORNIA—*Cont'd*		
Oakland	384,575	$ 84,606,500
Ontario	22,872	5,031,840
Oxnard	21,567	4,744,740
Palo Alto	25,475	5,604,500
Pasadena	104,577	23,006,940
Pomona	35,405	7,789,100
Redlands	18,429	4,054,380
Redondo Beach	25,226	5,549,720
Redwood City	25,544	5,619,680
Richmond	99,545	21,899,900
Riverside	46,764	10,288,080
Sacramento	137,572	30,265,840
San Bernardino	63,058	13,872,760
San Buenaventura	16,534	3,637,480
San Diego	334,387	73,565,140
San Francisco	775,357	170,578,540
San Gabriel	20,343	4,475,460
San Jose	95,280	20,961,600
San Leandro	27,542	6,059,240
San Mateo	41,782	9,192,040
Santa Ana	45,533	10,017,260
Santa Barbara	44,913	9,880,860
Santa Cruz	21,970	4,833,400
Santa Monica	71,595	15,750,900
Santa Rosa	17,902	3,938,440
South Gate	51,116	11,245,520
South Pasadena	16,935	3,725,700
South San Francisco	19,351	4,257,220
Stockton	70,853	15,587,660
Torrance	22,241	4,893,020
Vallejo	26,038	5,728,360
Whittier	23,820	5,240,400
COLORADO		
Boulder	19,999	4,399,780
Colorado Springs	45,472	10,003,840
Denver	415,786	91,472,920

	Population 1950	Pro rata share
Englewood	16,869	$ 3,711,180
Greeley	20,354	4,477,880
Pueblo	63,685	14,010,700
CONNECTICUT		
Ansonia	18,706	4,115,320
Bridgeport	158,709	34,915,980
Bristol	35,961	7,911,420
Danbury	22,067	4,854,740
Hartford	177,397	39,027,340
Meriden	44,088	9,699,360
Middletown	29,711	6,536,420
Naugatuck	17,455	3,840,100
New Britain	73,726	16,219,720
New Haven	164,443	36,177,460
New London	30,551	6,721,220
Norwalk	49,460	10,881,200
Norwich	23,429	5,154,380
Stamford	74,293	16,344,460
Torrington	27,820	6,120,400
Waterbury	104,477	22,984,940
DELAWARE		
Wilmington	110,356	24,278,320
FLORIDA		
Clearwater	15,581	3,427,820
Coral Gables	19,837	4,364,140
Daytona Beach	30,187	6,641,140
Fort Lauderdale	36,328	7,992,160
Gainesville	26,861	5,909,420
Hialeah	19,676	4,328,720
Jacksonville	204,517	44,993,740
Key West	26,433	5,815,260
Lakeland	30,851	6,787,220
Miami	249,276	54,840,720
Miami Beach	46,282	10,182,040
Orlando	52,367	11,520,740

	Population 1950	Pro rata share
FLORIDA—*Cont'd*		
Panama City	25,814	$ 5,679,080
Pensacola	43,479	9,565,380
St. Petersburg	96,738	21,282,360
Sarasota	18,896	4,157,120
Tallahassee	27,237	5,992,140
Tampa	124,681	27,429,820
West Palm Beach	43,162	9,495,640
GEORGIA		
Albany	31,155	6,854,100
Athens	28,180	6,199,600
Atlanta	331,314	72,889,080
Augusta	71,508	15,731,760
Brunswick	17,954	3,949,880
Columbus	79,611	17,514,420
Dalton	15,968	3,512,960
Decatur	21,635	4,759,700
East Point	21,080	4,637,600
La Grange	25,025	5,505,500
Macon	70,252	15,455,440
Marietta	20,687	4,551,140
Rome	29,615	6,515,300
Savannah	119,638	26,320,360
Valdosta	20,046	4,410,120
Waycross	18,899	4,157,780
IDAHO		
Boise City	34,393	7,566,460
Idaho Falls	19,218	4,227,960
Nampa	16,185	3,560,700
Pocatello	26,131	5,748,820
Twin Falls	17,600	3,872,000
ILLINOIS		
Alton	32,550	7,161,000
Aurora	50,576	11,126,720
Belleville	32,721	7,198,620

	Population 1950	Pro rata share
Berwyn	51,280	$ 11,281,600
Bloomington	34,163	7,515,860
Blue Island	17,622	3,876,840
Brookfield	15,472	3,403,840
Calumet City	15,799	3,475,780
Champaign	39,563	8,703,860
Chicago	3,620,962	796,611,640
Chicago Heights	24,551	5,401,220
Cicero	67,544	14,859,680
Danville	37,864	8,330,080
Decatur	66,269	14,579,180
East St. Louis	82,295	18,104,900
Elgin	44,223	9,729,060
Elmhurst	21,273	4,680,060
Elmwood Park	18,801	4,136,220
Evanston	73,641	16,201,020
Freeport	22,467	4,942,740
Galesburg	31,425	6,913,500
Granite City	29,465	6,482,300
Harvey	20,683	4,550,260
Highland Park	16,808	3,697,760
Jacksonville	20,387	4,485,140
Joliet	51,601	11,352,220
Kankakee	25,856	5,688,320
Kewanee	16,821	3,700,620
Mattoon	17,574	3,860,340
Maywood	27,473	6,044,060
Moline	37,397	8,227,340
Mt. Vernon	15,600	3,432,000
Oak Park	63,529	13,976,380
Ottawa	16,957	3,730,540
Park Ridge	16,602	3,652,440
Pekin	21,858	4,808,760
Peoria	111,856	24,608,320
Quincy	41,450	9,119,000
Rockford	92,927	20,443,940
Rock Island	48,710	10,716,200
Springfield	81,628	17,958,160

	Population 1950	Pro rata share
ILLINOIS—*Cont'd*		
Streator	16,469	$ 3,623,180
Urbana	22,834	5,023,480
Waukegan	38,946	8,568,120
Wilmette	18,162	3,995,640
INDIANA		
Anderson	46,820	10,300,400
Bloomington	28,163	6,195,860
Columbus	18,370	4,041,400
Connersville	15,550	3,421,000
East Chicago	54,263	11,937,860
Elkhart	35,646	7,842,120
Evansville	128,636	28,299,920
Fort Wayne	133,607	29,393,540
Frankfort	15,028	3,306,160
Gary	133,911	29,460,420
Hammond	87,594	19,270,680
Huntington	15,079	3,317,380
Indianapolis	427,173	93,978,060
Kokomo	38,672	8,507,840
Lafayette	35,568	7,824,960
La Porte	17,882	3,934,040
Logansport	21,031	4,626,820
Marion	30,081	6,617,820
Michigan City	28,395	6,246,900
Mishawaka	32,913	7,240,860
Muncie	58,479	12,865,380
New Albany	29,346	6,456,120
New Castle	18,271	4,019,620
Richmond	39,539	8,698,580
South Bend	115,911	25,500,420
Terre Haute	64,214	14,127,080
Vincennes	18,831	4,142,820
IOWA		
Ames	22,898	5,037,560
Burlington	30,613	6,734,860

	Population 1950	Pro rata share
Cedar Rapids	72,296	$15,905,120
Clinton	30,379	6,683,380
Council Bluffs	45,429	9,994,380
Davenport	74,549	16,400,780
Des Moines	177,965	39,152,300
Dubuque	49,671	10,927,620
Fort Dodge	25,115	5,525,300
Iowa City	27,212	5,986,640
Keokuk	16,144	3,551,680
Marshalltown	19,821	4,360,620
Mason City	27,980	6,155,600
Muscatine	19,041	4,189,020
Ottumwa	33,631	7,398,820
Sioux City	83,991	18,478,020
Waterloo	65,198	14,343,560
KANSAS		
Coffeyville	17,113	3,764,860
Emporia	15,669	3,447,180
Hutchinson	33,575	7,386,500
Kansas City	129,553	28,501,660
Lawrence	23,351	5,137,220
Leavenworth	20,579	4,527,380
Manhattan	19,056	4,192,320
Pittsburg	19,341	4,255,020
Salina	26,176	5,758,720
Topeka	78,791	17,334,020
Wichita	168,279	37,021,380
KENTUCKY		
Ashland	31,131	6,848,820
Bowling Green	18,347	4,036,340
Covington	64,452	14,179,440
Henderson	16,837	3,704,140
Lexington	55,534	12,217,480
Louisville	369,129	81,208,380
Newport	31,044	6,829,680
Owensboro	33,651	7,403,220
Paducah	32,828	7,222,160

	Population 1950	Pro rata share
LOUISIANA		
Alexandria	34,913	$ 7,680,860
Baton Rouge	125,629	27,638,380
Bogalusa	17,798	3,915,560
Bossier City	15,470	3,403,400
Lafayette	33,541	7,379,020
Lake Charles	38,572	9,079,840
Monroe	38,572	8,485,840
New Iberia	16,467	3,622,740
New Orleans	570,445	125,497,900
Shreveport	127,206	27,985,320
MAINE		
Auburn	23,134	5,089,480
Augusta	20,913	4,600,860
Bangor	31,558	6,942,760
Biddeford	20,836	4,583,920
Lewiston	40,974	9,014,280
Portland	77,634	17,079,480
South Portland	21,866	4,810,520
Waterville	18,287	4,023,140
MARYLAND		
Baltimore	949,708	208,935,760
Cumberland	37,679	8,289,380
Frederick	18,142	3,991,240
Hagerstown	36,260	7,977,200
Salisbury	15,141	3,331,020
MASSACHUSETTS		
Attleboro	23,809	5,237,980
Beverly	28,884	6,354,480
Boston	801,444	176,317,680
Brockton	62,860	13,829,200
Cambridge	120,740	26,562,800
Chelsea	38,912	8,560,640
Chicopee	49,211	10,826,420
Everett	45,982	10,116,040

	Population 1950	Pro rata share
Fall River	111,963	$24,631,860
Fitchburg	42,691	9,392,020
Gardner	19,581	4,307,820
Gloucester	25,167	5,536,740
Haverhill	47,280	10,401,600
Holyoke	54,661	12,025,420
Lawrence	80,536	17,717,920
Leominster	24,075	5,296,500
Lowell	97,249	21,394,780
Lynn	99,738	21,942,360
Malden	59,804	13,156,880
Marlborough	15,756	3,466,320
Medford	66,113	14,544,860
Melrose	26,988	5,937,360
New Bedford	109,189	24,021,580
Newton	81,994	18,038,680
North Adams	21,567	4,744,740
Northampton	29,063	6,393,860
Peabody	22,645	4,981,900
Pittsfield	53,348	11,736,560
Quincy	83,835	18,443,700
Revere	36,763	8,087,860
Salem	41,880	9,213,600
Somerville	102,351	22,517,220
Springfield	162,399	35,727,780
Taunton	40,109	8,823,980
Waltham	47,187	10,381,140
Westfield	20,962	4,611,640
Woburn	20,492	4,508,240
Worcester	203,486	44,766,920
MICHIGAN		
Adrian	18,393	4,046,460
Ann Arbor	48,251	10,615,220
Battle Creek	48,666	10,706,520
Bay City	52,523	11,555,060
Benton Harbor	18,769	4,129,180
Berkley	17,931	3,944,820

	Population 1950	Pro rata share
MICHIGAN—*Cont'd*		
Birmingham	15,467	$ 3,402,740
Dearborn	94,994	20,898,680
Detroit	1,849,568	406,904,960
East Detroit	21,461	4,721,420
East Lansing	20,325	4,471,500
Ecorse	17,948	3,948,560
Escanaba	15,170	3,337,400
Ferndale	29,675	6,528,500
Flint	163,143	35,891,460
Grand Rapids	176,515	38,833,300
Hamtramck	43,355	9,538,100
Hazel Park	17,770	3,909,400
Highland Park	46,393	10,206,460
Holland	15,858	3,488,760
Inkster	16,728	3,680,160
Jackson	51,088	11,239,360
Kalamazoo	57,704	12,694,880
Lansing	92,129	20,268,380
Lincoln Park	29,310	6,448,200
Livonia	17,534	3,857,480
Marquette	17,202	3,784,440
Monroe	21,467	4,722,740
Mt. Clemens	17,027	3,745,940
Muskegon	48,429	10,654,380
Muskegon Heights	18,828	4,142,160
Owosso	15,948	3,508,560
Pontiac	73,681	16,209,820
Port Huron	35,725	7,859,500
River Rouge	20,549	4,520,780
Roseville	15,816	3,479,520
Royal Oak	46,898	10,317,560
Saginaw	92,918	20,441,960
St. Clair Shores	19,823	4,361,060
Sault Ste. Marie	17,912	3,940,640
Traverse City	16,974	3,734,280
Wyandotte	36,846	8,106,120
Ypsilanti	18,302	4,026,440

	Population 1950	Pro rata share
MINNESOTA		
Austin	23,100	$ 5,082,000
Duluth	104,511	22,992,420
Faribault	16,028	3,526,160
Hibbing	16,276	3,580,720
Mankato	18,809	4,137,980
Minneapolis	521,718	114,777,960
Richfield	17,502	3,850,440
Rochester	29,885	6,574,700
St. Cloud	28,410	6,250,200
St. Louis Park	22,644	4,981,680
St. Paul	311,349	68,496,780
South St. Paul	15,909	3,499,980
Winona	25,031	5,506,820
MISSISSIPPI		
Biloxi	37,425	8,233,500
Clarksdale	16,539	3,638,580
Columbus	17,172	3,777,840
Greenville	29,936	6,585,920
Greenwood	18,061	3,973,420
Gulfport	22,659	4,984,980
Hattiesburg	29,474	6,484,280
Jackson	98,271	21,619,620
Laurel	25,038	5,508,360
Meridian	41,893	9,216,460
Natchez	22,740	5,002,800
Vicksburg	27,948	6,148,560
MISSOURI		
Cape Girardeau	21,578	4,747,160
Clayton	16,035	3,527,700
Columbia	31,974	7,034,280
Hannibal	20,444	4,497,680
Independence	36,963	8,131,860
Jefferson City	25,099	5,521,780
Jennings	15,282	3,362,040
Joplin	38,711	8,516,420

	Population 1950	Pro rata share
MISSOURI—*Cont'd*		
Kansas City	456,622	$100,456,840
Kirkwood	18,640	4,100,800
Poplar Bluff	15,064	3,314,080
Richmond Heights	15,045	3,309,900
St. Joseph	78,588	17,289,360
St. Louis	856,796	188,495,120
Sedalia	20,354	4,477,880
Springfield	66,731	14,680,820
University City	39,892	8,776,240
Webster Groves	23,390	5,145,800
MONTANA		
Billings	31,834	7,003,480
Butte	33,251	7,315,220
Great Falls	39,214	8,627,080
Helena	17,581	3,867,820
Missoula	22,485	4,946,700
NEBRASKA		
Grand Island	22,682	4,990,040
Hastings	20,211	4,446,420
Lincoln	98,884	21,754,480
North Platte	15,433	3,395,260
Omaha	251,117	55,245,740
NEVADA		
Las Vegas	24,624	5,417,280
Reno	32,497	7,149,340
NEW HAMPSHIRE		
Berlin	16,615	3,655,300
Concord	27,988	6,157,360
Dover	15,874	3,492,280
Keene	15,638	3,440,360
Manchester	82,732	18,201,040
Nashua	34,669	7,627,180
Portsmouth	18,830	4,142,600

	Population 1950	Pro rata share
NEW JERSEY		
Asbury Park	17,094	$ 3,760,680
Atlantic City	61,657	13,564,540
Bayonne	77,203	16,984,660
Belleville	32,019	7,044,180
Bergenfield	17,647	3,882,340
Bloomfield	49,307	10,847,540
Bridgeton	18,378	4,043,160
Camden	124,555	27,402,100
Cliffside Park	17,166	3,765,520
Clifton	64,511	14,192,420
Collingwood	15,800	3,476,000
East Orange	79,340	17,454,800
East Paterson	15,386	3,384,920
Elizabeth	112,817	24,819,740
Englewood	23,145	5,091,900
Fair Lawn	23,885	5,254,700
Garfield	27,550	6,061,000
Hackensack	29,219	6,428,180
Hoboken	50,676	11,148,720
Irvington	59,201	13,024,220
Jersey City	299,017	65,783,740
Kearny	39,952	8,789,440
Linden	30,644	6,741,680
Lodi	15,392	3,386,240
Long Branch	23,090	5,079,800
Millville	16,041	3,529,020
Montclair	43,927	9,663,940
Morristown	17,124	3,767,280
Newark	438,776	96,530,720
New Brunswick	38,811	8,538,420
North Arlington	15,970	3,513,400
Nutley	26,992	5,938,240
Orange	38,037	8,368,140
Passaic	57,702	12,694,440
Paterson	139,336	30,653,920
Perth Amboy	41,330	9,092,600
Phillipsburg	18,919	4,162,180

	Population 1950	Pro rata share
NEW JERSEY—*Cont'd*		
Plainfield	42,366	$ 9,320,520
Rahway	21,290	4,683,800
Ridgewood	17,481	3,845,820
Roselle	17,681	3,889,820
Rutherford	17,411	3,830,420
South Orange	15,230	3,350,600
Summit	17,929	3,944,380
Trenton	128,099	28,181,780
Union City	55,537	12,218,140
Westfield	21,243	4,673,460
West New York	37,683	8,290,260
West Orange	28,605	6,293,100
NEW MEXICO		
Albuquerque	96,815	21,299,300
Carlsbad	17,975	3,954,500
Clovis	17,318	3,809,960
Roswell	25,738	5,662,360
Santa Fe	27,998	6,159,560
NEW YORK		
Albany	134,995	29,698,900
Amsterdam	32,240	7,092,800
Auburn	36,722	8,078,840
Batavia	17,799	3,915,780
Binghamton	80,674	17,748,280
Buffalo	580,132	127,629,040
Cohoes	21,272	4,679,840
Corning	17,684	3,890,480
Cortland	18,152	3,993,440
Dunkirk	18,007	3,961,540
Elmira	49,716	10,937,520
Endicott	20,050	4,411,000
Freeport	24,680	5,429,600
Geneva	17,144	3,771,680
Glen Cove	15,130	3,328,600
Glens Falls	19,610	4,314,200

	Population 1950	Pro rata share
Gloversville	23,634	$ 5,199,480
Hempstead	29,135	6,409,700
Hornell	15,049	3,310,780
Ithaca	29,257	6,436,540
Jamestown	43,354	9,537,880
Johnson City	19,249	4,234,780
Kenmore	20,066	4,414,520
Kingston	28,817	6,339,740
Lackawanna	27,658	6,084,760
Lockport	25,133	5,529,260
Long Beach	15,586	3,428,920
Lynbrook	17,314	3,809,080
Mamaroneck	15,016	3,303,520
Middletown	22,586	4,968,920
Mount Vernon	71,899	15,817,780
Newburgh	31,956	7,030,320
New Rochelle	59,725	13,139,500
New York City	7,891,957	1,736,230,540
Niagara Falls	90,872	19,991,840
North Tonawanda	24,731	5,440,820
Ogdensburg	16,166	3,556,520
Olean	22,884	5,034,480
Ossining	16,098	3,541,560
Oswego	22,647	4,982,340
Peekskill	17,731	3,900,820
Plattsburg	17,738	3,902,360
Port Chester	23,970	5,273,400
Poughkeepsie	41,023	9,025,060
Rochester	332,488	73,147,360
Rockville Centre	22,362	4,919,640
Rome	41,682	9,170,040
Saratoga Springs	15,473	3,404,060
Schenectady	91,785	20,192,700
Syracuse	220,583	48,528,260
Troy	72,311	15,908,420
Utica	101,531	22,336,820
Valley Stream	26,854	5,907,880
Watertown	34,350	7,557,000

	Population 1950	Pro rata share
NEW YORK—*Cont'd*		
Watervliet	15,197	$ 3,343,340
White Plains	43,466	9,562,520
Yonkers	152,798	33,615,560
NORTH CAROLINA		
Asheville	53,000	11,660,000
Burlington	24,560	5,403,200
Charlotte	134,042	29,489,240
Concord	16,486	3,626,920
Durham	71,311	15,688,420
Fayetteville	34,715	7,637,300
Gastonia	23,069	5,075,180
Goldsboro	21,454	4,719,880
Greensboro	74,389	16,365,580
Greenville	16,724	3,679,280
High Point	39,973	8,794,060
Kinston	18,336	4,033,920
New Bern	15,812	3,478,640
Raleigh	65,679	14,449,380
Rocky Mount	27,697	6,093,340
Salisbury	20,102	4,422,440
Shelby	15,508	3,411,760
Statesville	16,901	3,718,220
Wilmington	45,043	9,909,460
Wilson	23,010	5,062,200
Winston Salem	87,811	19,318,420
NORTH DAKOTA		
Bismarck	18,640	4,100,800
Fargo	38,256	8,416,320
Grand Forks	26,836	5,903,920
Minot	22,032	4,847,040
OHIO		
Akron	274,605	60,413,100
Alliance	26,161	5,755,420
Ashtabula	23,696	5,213,120

	Population 1950	Pro rata share
Barberton	27,820	$ 6,120,400
Canton	116,912	25,720,640
Chillicothe	20,133	4,429,260
Cincinnati	503,998	110,879,560
Cleveland	914,808	201,257,760
Cleveland Hts.	59,141	13,011,020
Columbus	375,901	82,698,220
Cuyahoga Falls	29,195	6,422,900
Dayton	243,872	53,651,840
East Cleveland	40,047	8,810,340
East Liverpool	24,217	5,327,740
Elyria	30,307	6,667,540
Euclid	41,396	9,107,120
Findlay	23,845	5,245,900
Fremont	16,537	3,638,140
Garfield Heights	21,662	4,765,640
Hamilton	57,951	12,749,220
Ironton	16,333	3,593,260
Lakewood	68,071	14,975,620
Lancaster	24,180	5,319,600
Lima	50,246	11,054,120
Lorain	51,202	11,264,440
Mansfield	43,564	9,584,080
Maple Heights	15,586	3,428,920
Marietta	16,006	3,521,320
Marion	33,817	7,439,740
Massillon	29,594	6,510,680
Middletown	33,695	7,412,900
Newark	34,275	7,540,500
Niles	16,773	3,690,060
Norwood	35,001	7,700,220
Parma	28,897	6,357,340
Pigua	17,447	3,838,340
Portsmouth	36,798	8,095,560
Sandusky	29,375	6,462,500
Shaker Heights	28,222	6,208,840
South Euclid	15,432	3,395,040
Springfield	78,508	17,271,760

	Population 1950	Pro rata share
OHIO—*Cont'd*		
Steubenville	35,872	$ 7,891,840
Tiffin	18,952	4,169,440
Toledo	303,616	66,795,520
Warren	49,856	10,968,320
Youngstown	168,330	37,032,600
Zanesville	40,517	8,913,740
OKLAHOMA		
Ada	15,995	3,518,900
Ardmore	17,890	3,935,800
Bartlesville	19,228	4,230,160
Chickasha	15,842	3,485,240
Duncan	15,325	3,371,500
Enid	36,017	7,923,740
Lawton	34,757	7,646,540
McAlester	17,878	3,933,160
Muskogee	37,289	8,203,580
Norman	27,006	5,941,320
Oklahoma City	243,504	53,570,880
Okmulgee	18,317	4,029,740
Ponca City	20,180	4,439,600
Shawnee	22,948	5,048,560
Stillwater	20,238	4,452,360
Tulsa	182,740	40,202,800
OREGON		
Corvallis	16,207	3,565,540
Eugene	35,879	7,893,380
Klamath Falls	15,875	3,492,500
Medford	17,305	3,807,100
Portland	373,628	82,198,160
Salem	43,140	9,490,800
PENNSYLVANIA		
Aliquippa	26,132	5,749,040
Allentown	106,756	23,486,320
Altoona	77,177	16,978,940

	Population 1950	Pro rata share
Ambridge	16,429	$ 3,614,380
Beaver Falls	17,375	3,822,500
Bethlehem	66,340	14,594,800
Braddock	16,488	3,627,360
Bradford	17,354	3,817,880
Butler	23,482	5,166,040
Carbondale	16,296	3,585,120
Carlisle	16,812	3,698,640
Chambersburg	17,212	3,786,640
Chester	66,039	14,528,580
Clairton	19,652	4,323,440
Dunmore	20,305	4,467,100
Duquesne	17,620	3,876,400
Easton	35,632	7,839,040
Erie	130,803	28,776,660
Greensburg	16,923	3,723,060
Harrisburg	89,544	19,699,680
Hazleton	35,491	7,808,020
Jeannette	16,172	3,557,840
Johnstown	63,232	13,911,040
Kingston	21,096	4,641,120
Lancaster	63,774	14,030,280
Lebanon	28,156	6,194,320
McKeesport	51,502	11,330,440
McKees Rocks	16,241	3,573,020
Meadville	18,972	4,173,840
Monessen	17,896	3,937,120
Munhall	16,437	3,616,140
Nanticoke	20,160	4,435,200
New Castle	48,834	10,743,480
New Kensington	25,146	5,532,120
Norristown	38,126	8,387,720
Oil City	19,581	4,307,820
Philadelphia	2,071,605	455,753,100
Pittsburgh	676,806	148,897,320
Pittston	15,012	3,302,640
Pottstown	22,589	4,969,580
Pottsville	23,640	5,200,800

	Population 1950	Pro rata share
PENNSYLVANIA—*Cont'd*		
Reading	109,320	$24,050,400
Scranton	125,536	27,617,920
Shamokin	16,879	3,713,380
Sharon	26,454	5,819,880
Shenandoah	15,704	3,454,880
State College	17,227	3,789,940
Sunbury	15,570	3,425,400
Swissvale	16,488	3,627,360
Uniontown	20,471	4,503,620
Washington	26,280	5,781,600
West Chester	15,168	3,336,960
West Mifflin	17,985	3,956,700
Wilkes-Barre	76,826	16,901,720
Wilkinsburg	31,418	6,911,960
Williamsport	45,047	9,910,340
York	59,953	13,189,660
RHODE ISLAND		
Central Falls	23,550	5,181,000
Cranston	55,060	12,113,200
Newport	37,564	8,264,080
Pawtucket	81,436	17,915,920
Providence	248,674	54,708,280
Warwick	43,028	9,466,160
Woonsocket	50,211	11,046,420
SOUTH CAROLINA		
Anderson	19,770	4,349,400
Charleston	70,174	15,438,280
Columbia	86,914	19,121,080
Florence	22,513	4,952,860
Greenville	58,161	12,795,420
Orangeburg	15,322	3,370,840
Rock Hill	24,502	5,390,440
Spartanburg	36,795	8,094,900
Sumter	20,185	4,440,700

	Population 1950	Pro rata share
SOUTH DAKOTA		
Aberdeen	21,051	$ 4,631,220
Rapid City	25,310	5,568,200
Sioux Falls	52,696	11,593,120
TENNESSEE		
Bristol	16,771	3,689,620
Chattanooga	131,041	28,829,020
Clarksville	16,246	3,574,120
Jackson	30,207	6,645,540
Johnson City	27,864	6,130,080
Kingsport	19,571	4,305,620
Knoxville	124,769	27,449,180
Memphis	396,000	87,120,000
Nashville	174,307	38,347,540
TEXAS		
Abilene	45,570	10,025,400
Alice	16,449	3,618,780
Amarillo	74,246	16,334,120
Austin	132,459	29,140,980
Baytown	22,983	5,056,260
Beaumont	94,014	20,683,080
Big Spring	17,286	3,802,920
Borger	18,059	3,972,980
Brownsville	36,066	7,934,520
Brownwood	20,181	4,439,820
Bryan	18,102	3,982,440
Corpus Christi	108,287	23,823,140
Corsicana	19,211	4,226,420
Dallas	434,462	95,581,640
Denison	17,504	3,850,880
Denton	21,372	4,701,840
El Paso	130,485	28,706,700
Fort Worth	278,778	61,331,160
Galveston	66,568	14,644,960
Harlingen	23,229	5,110,380
Houston	596,163	131,155,860

	Population 1950	Pro rata share
TEXAS—*Cont'd*		
Kingsville	16,898	$ 3,717,560
Laredo	51,910	11,420,200
Longview	24,502	5,390,440
Lubbock	71,747	15,784,340
Lufkin	15,135	3,329,700
McAllen	20,067	4,414,740
Marshall	22,327	4,911,940
Midland	21,713	4,776,860
Odessa	29,495	6,488,900
Orange	21,174	4,658,280
Pampa	16,583	3,648,260
Paris	21,643	4,761,460
Pasadena	22,483	4,946,260
Port Arthur	57,530	12,656,600
San Angelo	52,093	11,460,460
San Antonio	408,422	89,852,840
Sherman	20,150	4,433,000
Temple	25,467	5,602,740
Texarkana	24,753	5,445,660
Texas City	16,620	3,656,400
Tyler	38,968	8,572,960
University Park	24,275	5,340,500
Victoria	16,126	3,547,720
Waco	84,706	18,635,320
West Univ. Place	17,074	3,756,280
Wichita Falls	68,042	14,969,240
UTAH		
Logan	16,832	3,703,040
Ogden	57,112	12,564,640
Provo	28,937	6,366,140
Salt Lake City	182,121	40,066,620
VERMONT		
Burlington	33,155	7,294,100
Rutland	17,659	3,884,980

	Population 1950	Pro rata share
VIRGINIA		
Alexandria	61,787	$ 13,593,140
Bristol	15,954	3,509,880
Charlottesville	25,969	5,713,180
Danville	35,066	7,714,520
Lynchburg	47,727	10,499,940
Martinsville	17,251	3,795,220
Newport News	42,358	9,318,760
Norfolk	213,513	46,972,860
Petersburg	35,054	7,711,880
Portsmouth	80,039	17,608,580
Richmond	230,310	50,668,200
Roanoke	91,921	20,222,620
Staunton	19,927	4,383,940
WASHINGTON		
Aberdeen	19,653	4,323,660
Bellingham	34,112	7,504,640
Bremerton	27,678	6,089,160
Everett	33,849	7,446,780
Longview	20,339	4,474,580
Olympia	15,819	3,480,180
Renton	16,039	3,528,580
Seattle	467,591	102,870,020
Spokane	161,721	35,578,620
Tacoma	143,673	31,608,060
Vancouver	41,644	9,161,680
Walla Walla	24,102	5,302,440
Yakima	38,486	8,466,920
WEST VIRGINIA		
Beckley	19,397	4,267,340
Bluefield	21,506	4,731,320
Charleston	73,501	16,170,220
Clarksburg	32,014	7,043,080
Fairmont	29,346	6,456,120
Huntington	86,353	18,997,660
Martinsburg	15,621	3,436,620

	Population 1950	Pro rata share
WEST VIRGINIA—*Cont'd*		
Morgantown	25,525	$ 5,615,500
Parkersburg	29,684	6,530,480
South Charleston	16,686	3,670,920
Weirton	24,005	5,281,100
Wheeling	58,891	12,956,020
WISCONSIN		
Appleton	34,010	7,482,200
Beloit	29,590	6,509,200
Eau Claire	36,058	7,932,760
Fond du Lac	29,936	6,585,920
Green Bay	52,735	11,601,700
Janesville	24,899	5,477,780
Kenosha	54,368	11,960,960
La Crosse	47,535	10,457,700
Madison	96,056	21,132,320
Manitowoc	27,598	6,071,560
Milwaukee	637,392	140,226,240
Oshkosh	41,084	9,038,480
Racine	71,193	15,662,460
Sheboygan	42,365	9,320,300
Shorewood	16,199	3,563,780
Stevens Point	16,564	3,644,080
Superior	35,325	7,771,500
Waukesha	21,233	4,671,260
Wausau	30,414	6,691,080
Wauwatosa	33,324	7,331,280
West Allis	42,959	9,450,980
WYOMING		
Caspar	23,673	5,208,060
Cheyenne	31,935	7,025,700
Laramie	15,581	3,427,820
TERRITORY OF HAWAII		
Hilo	27,019*	5,944,180
Honolulu	245,612*	54,034,640

* Preliminary count, 1950

Expansion of the cities can be handled by the cities themselves, but they will need financial assistance. An estimate, calculated with great care, puts at 15 billion dollars the amount of federal aid that will be required. This is in addition to what the cities must do for themselves and the aid they should receive from their state governments. (The Appendix lists all cities reported in the 1950 Census as exceeding 15,000 population, and gives the pro rata share each would receive from an appropriation of 15 billion dollars.)

The author does not overlook the fact that 15 billion dollars even in these days is a huge sum, and that appropriations for many other things may have to be pruned to make such a sum available. But cost is not to be weighed against the terrible probability that 837 cities will be destroyed, all their millions of residents killed or made homeless and destitute, and practically all of the manufacturing facilities of the nation ruined, if complete atomic defense for the cities is not achieved.

In addition to the cities, the author analyses the vulnerability to atomic attack of the gigantic dams, irrigated regions, wheat lands, areas of dense forests, and other major objects—and recommends measures for their defense.

Total Atomic Defense, we believe, is the first published work to insist that, if we can be stirred to the right kind of efforts, we can have in America a defense that will spare our homes, industries, and resources from the weapons of atomic warfare. This is a book that should be read by everyone. And the measures of civilian defense it recommends might well be discussed by civic organizations, business and professional clubs, posts of veterans, chapters of farm societies, farmers' cooperatives, and at the meetings of various other groups.